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May 1959

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Capacity Utilization

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Constructing and Using Profit and Loss Statements By Division and Market

by R. V. JOHNSON and J. L. SHINN

As MANUFACTURER in the electronic control field, we shared in the above average post World War II prosperity of many firms in electronics. Such a period of prosperity for an entire industry is an open invitation to additional competition bent on "sharing the wealth." This competition makes it imperative that each company know which of its lines or markets are most profitable and channel its efforts into these profitable directions.

This period has seen a rapid increase in productivity and costs. Cost levels, unfortunately, do not move in direct proportion to productivity. In fact, costs have increased at a faster rate than production. Increased costs have two possible results: increased selling prices or lower profits. Higher selling prices are not always acceptable to the customers who may change to a competitive product or merely forego plans which include our products. Lower profits are seldom acceptable to company management and stockholders. The only alternative is cost control.

Goals Sought; Structure of the Statements

In an effort to provide both a measure of profitability by market and a means of cost control in our sales areas, our company began publishing sales profit and loss statements by sales division and sales market. All costs were assigned specifically where possible. Costs not specifically assignable were allocated on the most equitable basis consistent with good accounting principles. In establishing these profit and loss statements, we first outlined certain goals, the attainment of which we felt was imperative to the maximum effectiveness of the report. Among these goals were the following:

1. Make sales areas cost conscious, not just at the gross profit level but at all levels. Sales should recover *all* of the company expenses and return a profit.

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2. Make the report understandable and useful to sales personnel. To attain this goal, sales management was given a strong voice in all stages of the report design.
3. Gain and maintain sales management's confidence in the report by being consistent within good accounting principles and by analyzing specific costs on request.
4. Maintain close communication with the sales departments personnel to impress them that we are as concerned with individual profit margins as we are with over-all reporting of facts for top management. Make cost control and profit margins a joint effort.

Our sales profit and loss statement departs from the traditional statement format. The latter shows net sales, factory costs, gross profit, selling and general and administrative costs and net income before taxes. Our statement (Exhibit 1) is divided into five cost groups resulting in five profit levels: gross factory margin, sales division direct profit margin, sales division margin, margin after direct costs and profit before taxes. The degree of controllability of each group of costs decreases as one progresses down the statement, with one exception explained subsequently.

SALES PROFIT AND LOSS STATEMENT BY MARKETS AND DIVISIONS

	A Market	B Market	Total A & B Divisions	(Other Markets and Divisions)	Total Company
Net sales					
Cost of sales					
Product cost at standard					
Gross factory margin (Prod. cost @ Std.)					
Ratio to net sales					
Selling costs - direct					
Home Office					
Advertising and sales promotion					
Branch					
Total selling costs - direct					
Sales Division direct profit margin					
Ratio to net sales					
Selling costs - indirect					
Home Office					
Branch					
Total selling costs - indirect					
Sales Division margin					
Ratio to net sales					
Less: Engineering design					
"In-Guarantee" costs					
Margin after direct costs					
Ratio to net sales					
Other cost of sales					
Research					
Variance amortization					
Interdivisional purchase costs in excess of standard					
Shipping Department costs					
Other costs and income					
Engineering costs adjusted to formula					
G & A expense					
Total other costs					

EXHIBIT 1

The ultimate of control exercised by the sales departments is in establishing the sales prices. How much mark-up from standard cost is necessary to yield an acceptable profit, yet meet competition? Profit may vary by class of customer, but how much? It is sometimes better to accept little or no profit on certain devices to enable us to sell companion devices returning an acceptable profit. Which devices qualify? What rate of profit is acceptable on these "loss leader" devices? The answers to these questions are determined by the sales divisions and have a direct effect on the gross margin.

Cost of Sales and Selling Costs

The first cost we associate with any sale is the standard cost of the product. This cost is of prime importance to the sales area even though it has no part in setting the standard. The sales division can favorably influence the gross factory margin following these standard costs on the statement by concentrating sales efforts on products with the largest margins.

The cost of sales (standard cost) excludes the variance between the standard cost of the products and the actual factory cost of production for two reasons. First, the sales departments have no control over this variance. Secondly, eliminating the variance from cost of sales allows us to pinpoint the total effect of customer and product mix on the gross margin. The ratio of standard costs to net sales is entirely dependent upon product or customer mix. Product mix is analyzed in a "model summary" (listing quantities of each device sold, with total sales dollars and standard costs). Customer mix can be determined from a "sales by division" report which details dollar sales by sales division and by customer classification. On no other company statement is it possible to separate the effects of customer and product mix from the effects of varying factory costs.

The next important cost control group is direct selling costs, consisting of home office and branch direct selling costs and advertising and sales promotion. Home office direct selling expenses are detailed in a separate control report (Exhibit 2). The exact accounts to be included on this control report were negotiated with the sales divisions to assure their complete agreement. Every charge on the control report is controlled by the sales manager. Advertising and sales promotion expenditures are allocated to the sales divisions requesting the expenditures. Control again rests with the sales manager. Branch direct selling expenses are expenses incurred by the branch salesmen (salaries and expenses, including auto expenses) who are assigned to specific

divisions or markets within a division. Expense reports are examined and approved by the branch managers and audited by the home office accounting department.

EXPENSE CONTROL REPORT

From: Date Page Of

SALARIES	This Month			Year To Date		
	Plan	Actual	(Over) or Under Plan	Plan	Actual	(over) or Under Plan

EXHIBIT 2

Indirect selling costs, like the direct, were categorized with the cooperation of the sales divisions. They include such expenses as rent, light, heat, photograph laboratory charges, company plane, training school, etc. Even though a sales division does have some control over these expenses, it is so limited that we have classified them as indirect. For example, a sales division could elect to use the company plane 25 hours rather than 50 hours a month. This, of course, would reduce the division's costs, but it has no control over the extent to which the other divisions will use the plane and thus absorb a part of the total plane cost.

We have taken liberties with normal accounting practice in classifying expenses as direct or indirect. However, that is what we think we must do to provide a profit and loss statement which measures sales department performance.

Other Direct Costs — And Other Costs

We have included as "other direct costs," costs that are more controllable than the indirect selling costs above. The reason is to facilitate finding the "cost to sell" ratio—an important bench mark for the sales division. Previously, this was the *only* cost the sales divisions felt they could deal with effectively. They thought that, if they maintained a specific "cost to sell ratio," they were doing their part in the over all company picture. The divisional profit and loss statement provides new yardsticks yet includes the "cost to sell" ratio for use in comparison to past performance.

Other direct costs are the engineering design and in-guarantee costs. Until we began assignment of engineering costs on the basis of responsibility, they were allocated to the sales divisions on the basis of standard costs. When a

sales division manager requested the engineering department to work on projects he had a "hunch" would sell, the cost was not charged specifically to his division. The sales manager was not routinely informed of the costs of these engineering projects. Unless he had a special interest in a project, he did not necessarily review the project costs in terms of potential sales. Now, however, through the cooperation of the engineering section, we can obtain engineering charges by sales divisions and by markets. The sales divisions also receive a report that details expenditures by devices—a direct tie-in to the profits and loss statement. We can cite numerous examples of engineering projects stopped before completion because the sales division manager had the necessary information to determine that sales potential did not justify additional engineering costs.

In-guarantee costs are also included under the caption of other direct costs. These costs might be laid to faulty manufacture or poor inspection. However, we know we have an effective quality control check on products before they are offered for sale. These costs are therefore considered a result of the sales division's policy in respect to adjustments.

It is at this level that the sales divisions' and market managers' responsibility would normally be thought to end. However, each sales division's desire to show the best possible effort for its division or market has led to inquiries into the next and last segregation of costs, namely, other costs of sales. For example, the concern shown by the sales departments with inter-factory allocations resulted in studies to determine the best allocation of each factory cost, such as a recent study on intra-company purchase costs in excess of standard. This study necessitated our finding the proposed purchase costs that were to be booked during the year and the products (by market) to be assessed for these costs. It also required a review of sales credit history, that is, each division's share of sales credit for the products in question. The results of this study have brought about a more equitable allocation of costs, which is, therefore, more acceptable to the sales divisions.

Distribution of the Report

This divisional and market profit and loss statement, when first introduced, was typed and reproduced by multigraph. This meant approximately four days of reproduction time. It was obvious that a faster method of reproduction had to be found. We have now reduced the reproduction time to one working day by having the report hand-written and reproduced on Ozalid. With this

reproduction process, the report is now issued on the fourteenth working day of each month.

Distribution of the report is varied. The complete report is issued to operating management. Each sales division manager receives a recapitulation for his division, as well as the individual statements for each market in his division. Each market manager receives only the statement for his market.

More Selling Costs In Focus for Control

This sales profit and loss statement has had many tangible results. The sales departments are paying more attention to costs because of it. A good measure of this interest is the number of inquiries received concerning items on the statement, especially those items over which sales personnel previously thought they had no control. The new emphasis on profit margins has caused market managers to re-examine their product lines, "cull out" low profit items and concentrate their sales efforts on more profitable lines. Engineering design costs are now detailed by product. The sales manager can now see and control the engineering costs for which he is held responsible. Advertising costs are now specific by sales market. As a result, sales managers want to be sure they get the maximum results from their advertising dollar. Closer contact between sales and accounting has resulted in a better understanding of mutual problems and joint effort toward equitable allocations of costs among the sales markets. We feel that our company has attained a good measure of success in achieving the goals outlined for the report and that cost control by the sales divisions is a reality.

A Practical Maintenance Shop Cost Reduction Incentive Plan

by ROBERT P. KEEHN

MANY INCENTIVE PLANS have been developed, discussed and recorded but little has been published about maintenance shop incentive plans *per se*. Generally, the bulk of the incentive plans have concerned themselves with the direct productive worker while the indirect worker has gone without. In fact, such was the case at our company until recently. Now every single employee in our plant, regardless of department, is included in an incentive plan. This article will be devoted to the incentive plan in our maintenance shop. Our maintenance shop is, no doubt, similar to those in other companies. It devotes itself to maintenance and repair of our present equipment plus occasional construction and installation of new equipment. The main emphasis of the department is to keep the production equipment going so that a minimum loss in production occurs as a result of down-time due to maintenance.

We manufacture carbon paper which is used primarily by printers in the production of snap-out and continuous forms. Our raw material (paper and ink) is processed in our coating department where the ink is applied to the paper by high-speed machine application. The product is further processed in our finishing department where the carbon paper is slit to specified length and width rolls or cut to specified flat sheet sizes. The carbon paper in finished form then passes to our wrapping and packaging departments and on to shipping.

Maintenance costs as described in this article include the wages of the maintenance shop and related personnel, repair parts on machinery and equipment, miscellaneous operating supplies used in the maintenance shop, etc. The greater part of our maintenance work (60 per cent) takes place in our coating department where the carbon paper is actually made. It is highly important that the machines be kept operating efficiently and at near maximum capacity. When these machines are down, profits suffer. These costs have exceeded 10 per cent of the total manufacturing costs, exclusive of raw materials (paper and ink). This is higher than the average reported by Mr. P. M. Chiuminatto of

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Charmin Paper Mills, Inc., Green Bay, Wisconsin at the NAA's 1956 Annual Cost Conference in Chicago. As recorded in the 1956 Conference Proceedings he stated that, of the companies represented in his discussion group, the maintenance costs averaged between 4.7 per cent and 9.0 per cent of the manufacturing cost, exclusive of raw materials.

Amplified Reporting to Aid in Study of Maintenance

The fact that our maintenance costs were increasing was one of the motivating factors for the establishment of this plan. Another contributing factor was dissatisfaction expressed by the maintenance men that they were not a part of any incentive plan. As our first step, to get a complete picture of our cost problem, separate detailed schedules were included in our monthly financial report giving a breakdown of our maintenance shop costs. Schedule 9 in our monthly financial report appears as in Exhibit 1. (The figures used in the Exhibits are hypothetical). The objective in Schedule 9 was to itemize or break down the maintenance shop costs by items of machinery and equipment. Since the coating department accounts for the major portion of this cost, a detailed breakdown by each coating machine was included. Futhermore, since special grinding time constitutes a major portion of the coating maintenance hours, this cost factor was disclosed separately. With a bit of imagination one can now see the possibilities of this schedule—to show the relationship of maintenance to production by machine, by department, or to underlie a profitability study by machine, a guide to machine replacement, etc. Schedule 9 gives the current month's results as well as the accumulated year to date figures.

SCHEDULE 9 -- ANALYSIS OF MAINTENANCE AND REPAIRS ON MACHINERY AND EQUIPMENT

Coating Dept. Mach. No.	Hrs. Maint.	Hrs. Grinding	Hrs. Total	Labor Cost	Repair Parts	Total Maint.
1	2.2	--	2.2	$ 4.91	61.83	66.74
2	6.8	--	6.8	15.16	77.06	92.22
3	355.5	6.3	361.8	806.81	176.85	983.66
4	61.8	49.0	110.8	247.08	77.07	324.15
5	74.9	43.1	118.0	263.14	166.17	429.31
6	80.5	62.4	142.9	318.67	75.49	394.16
etc.	etc.	etc.	etc.	etc.	etc.	etc.
Total Coating	624.0	220.6	844.6	$1,883.45	943.60	2,827.05
Slitting Dept.			98.2	218.99	38.25	257.24
Processing Dept.			27.1	60.43	49.73	110.16
Reaming Dept.			69.6	155.21	32.50	187.71
etc.			rtc.	etc.	etc.	etc.
Total Maintenance Shop Costs			1,392.0	$3,104.16	1,162.90	4,267.06

EXHIBIT 1

SCHEDULE 8 -- ANALYSIS OF MAINTENANCE COSTS

	BUDGET	ACTUAL	VARIANCE
Salaries & Wages			
Maintenance Shop Salaries	$ 1,000.00	$ 1,000.00	---
Maintenance Shop Group Incentive Earnings	---	644.72	644.72
Maintenance Shop Labor - from Sched. 9	4,432.00	3,104.16	(1,327.84)
Experimental Labor - Maintenance Shop	542.00	353.81	(188.19)
Carpenter Wages	679.00	602.37	(76.63)
Waste Disposal Wages	1,034.00	959.55	(74.45)
Crib Attendant Wages	301.00	271.20	(29.80)
Custodian Wages	891.00	831.49	(59.51)
Total Salaries & Wages	$ 8,879.00	$ 7,767.30	$(1,111.70)
Maintenance & Repairs - Machinery & Equipment - from Schedule 9	2,399.00	1,162.90	(1,236.10)
Maintenance & Repairs - Trucks	159.00	113.24	(45.76)
Maintenance & Repairs - Buildings	1,500.00	792.60	(707.40)
Land Improvements - Parking Lot, etc.	83.00	----	(83.00)
Other Costs:			
Light Fixtures & Tubes	128.00	11.84	(116.16)
Custodian Supplies	316.00	402.05	86.05
Development & Experimental Supplies & Expense	334.00	700.45	366.45
Misc. Operating Supplies & Expense	696.00	830.67	134.67
Total Other Costs	1,474.00	1,945.01	471.01
Total Maintenance Costs	$14,494.00	11,781.05	(2,712.95)

EXHIBIT 2

Next, these totals on Schedule 9 are brought forward to Schedule 8, Analysis of Maintenance Costs, which appears in Exhibit 2. Schedule 8 also gives the accumulated year to date figures as well as the current month's results. The figures from Schedule 8 are brought forward into Schedule 2 which is a statement of period manufacturing expenses. This then makes the maintenance picture complete for the month and year to date and places it in its proper perspective. Note that all maintenance costs in the plant have been brought together into one schedule and all the salaries and wages pertaining to maintenance costs have been grouped on this schedule. This is desirable for analytical reasons and especially beneficial when all schedules in the financial report have a grouping pertaining to salaries and wages by department or function.

After having compiled the historical data on maintenance costs and satisfied that we were able to get accurate monthly figures of results of current operations, we were ready for our next step. We were generally agreed at this point that, if we could devise a good incentive program for the maintenance shop workers, we would take care of two objectives:

1. To satisfy the maintenance shop personnel who felt that it was unfair for the direct productive employees to have an incentive plan and not have a plan for them.
2. To reduce maintenance costs.

Developing Maintenance Cost Relationships

We continued to analyze past experience on maintenance costs. We related and plotted in graph form the relationship of maintenance costs to coating department production. Was maintenance cost actually a variable expense or was it strictly a period or fixed expense? Could this expense area be controlled to any extent? How helpful could the maintenance men themselves be in reducing maintenance costs? In analyzing the maintenance costs, we determined that certain of the items could be "controlled" or "influenced" by the maintenance shop men themselves. These items were the following, taken from Schedule 8:

Maintenance shop labor
Carpenter wages
Waste disposal wages
Elevator and crib attendant
Custodian wages
Maintenance & repairs on machinery & equipment
Other costs
(Maintenance shop labor on capital jobs)

These items represented approximately 75 per cent of the total maintenance cost and, if we were to eliminate the "fixed" salaries, would represent 82 per cent of the remaining maintenance cost. We excluded the following items:

Maintenance shop salaries
Experimental labor — Maintenance shop
Truck repairs & maintenance
Building repairs & maintenance
Land improvements

We felt the maintenance shop worker could not control or influence the cost of these items to any great extent, but it will be noted that we did include the cost of maintenance shop labor on capital jobs which is capitalized and not charged to expense on Schedule 8. Because of the nature of our plan, it is highly desirable for the maintenance shop personnel working on new equipment items to complete them as soon as possible, so that they may start helping increase good production and/or reduce waste and/or reduce the maintenance cost of present old equipment.

After further research we came to the conclusion that controllable maintenance costs are related to the coating department production. (Remember that approximately 60 per cent of the maintenance is in the coating department). As a result of our plotting and analyzing, we determined that approximately 50 per cent of the maintenance shop expense which we termed controllable was variable and increased or decreased in direct proportion to the carbon paper produced in the coating department. The other 50 per cent was fixed in nature and, as far as we could determine, did not materially fluctuate with changes in production levels.

This then, gave us a good starting point. It meant that we needed two standards, one for the variable portion and the other for the period or fixed portion of the expense.

To determine the base point for the variable portion of our standard, we started with the production report for the coating department. This report gives the number of pounds of carbon paper produced in the department each month. This information is available within two or three days after the close of the month. The pounds of paper shown on this report represent good carbon paper as far as the coating department is concerned. We mean by "good" carbon paper that any setup waste, etc. in the coating department has already been deleted and not included in these weights. However, the waste that was not removed from the roll of carbon paper in the coating department is deleted in the finishing departments. A report of the waste taken out in each finishing department, plus the waste incurred in the finishing operation, is received within a few days after the close of each month. By taking the total pounds of "good" carbon paper from the coating department and deducting the actual waste in the finishing departments, we arrive at the good (salable) carbon paper actually produced during the month. True, there could be some inventory fluctuation between departments but our operation enjoys a rapid turnover of material and such fluctuation, if any, would be negligible. Also, by bringing in the waste factor from the finishing departments, we are giving the primary emphasis to the coating department where the bulk of the maintenance is performed.

To determine the standard to apply to our "base point" of good carbon paper produced, we obtained the annual forecast good production and related it to 50 per cent of the annual budgeted cost for the controllable items. This gave us a ratio of $4.30 per 1,000 pounds of good carbon paper produced, to use as a standard allowance. To determine the standard to apply for the period or fixed portion, we simply took 50% of the budgeted cost for the controllable items and this gave us a monthly standard allowance of $6,000.

With these two standards established, we were now in a position to determine the savings or loss each month as follows:

1. "Good" carbon paper produced in coating dept.	1,200,000 lbs.
2. Deduct waste in finishing depts.	50,000 lbs.
3. Good (salable) carbon paper produced	1,150,000 lbs.

4.	Standard allowance for variable portion@ $4.30 x 1,000 lbs.	$ 4,945.00
5.	Standard allowance for fixed portion	6,000.00
6.	Total standard allowance	10,945.00
7.	Actual maintenance shop cost (controllable items)	8,876.68
8.	Savings over standard allowance	$ 2,068.32

Should all of the savings as computed above be distributed? If not, how much should be distributed? Should a portion be set aside in a fund for distribution at the close of the year? After weighing many possibilities, we decided that a fair distribution would be 50 per cent—meaning a 50-50 split on savings between the employees responsible and the company. Thus our computation continues:

9.	Savings are multiplied by bonus factor of .5	$ 1,034.16

These computations represent the result for one month. However, does one month's experience present a good picture of what actually happened? We realized, in our accumulating of actual costs, that overlapping of invoices could be a problem—enough of a problem so that high savings could be reflected one month and losses shown another month. Furthermore, maintenance costs have a tendency to lag or follow high production, not necessarily in the same month. This constituted another overlapping area. With these factors in mind, we adopted a three-month moving average. Hence, our computation continues as follows:

10.	Last month bonus fund—savings (or loss)	$ 500.00
11.	Two months ago bonus fund—savings (or loss)	400.00
12.	Three months bonus fund total	$ 1,934.16
13.	Three months moving average—savings (or loss)	$ 644.72

Payment of Maintenance Incentives; Sundry Provisions

This brings us to the distribution of the bonus fund. Our first step was to total all the individual hours worked by the employees in the maintenance shop and related personnel during the month. However, we realized that a portion of the employees included were either part-time help or "transfer ins" from other departments on a temporary basis, neither group actually contributing materially to the success of the cost reduction incentive plan. Therefore, we

decided to eliminate all employees who had worked less than 32 hours during the month in the maintenance shop or its related areas. This also meant that it was not necessary to write a number of small checks to various individuals. The balance of the hours of the eligible employees was divided into the bonus fund to determine the cents per hour to be paid to all participating or eligible employees. Our computation continues.

14. Total hours worked during the month ..... 4904.5 hrs.
15. Ineligible hours—employees who worked less than 32 hours in the machine shop..... 19.6 hrs.
16. Difference represents hours worked by the eligible employees ..... 4884.9 hrs.

Eligibility includes all maintenance men, carpenters, maintenance shop crib attendant, waste disposal employees who are responsible for baling and disposing of the waste, and the custodians. All of these employees use or are responsible for various items included in the controllable list. Furthermore, most of them are in an excellent position to make suggestions or recommendations on our operation to increase production, reduce waste, decrease maintenance costs, etc. A number of them, in their daily tasks, can directly influence the movement of finished materials and waste, thereby contributing to or helping make possible the attainment and continuation of high production levels. And, of course, most of them, through maintenance and repair work, contribute extensively to keeping the production equipment going at top efficiency.

This all-inclusive eligibility points to one aspect of the simplicity of our plan. There is no necessity for keeping detailed records of time devoted to each task or craft or duty and, thus, no need for individual detailed and lengthy standards. The difficulty in transferring employees between various tasks or duties is lessened. All of the employees included in this plan are responsible to the maintenance superintendent. Our computation continues:

17. As the last step prior to computing the check we divided the bonus fund ($644.72) by the hours of the eligible employees (4884.9 hrs.) to arrive at the cents per hour to be paid ..... 13.20¢

An innovation adopted at this point was that, should the incentive fund be the equivalent of 3¢ per hour or less, the distribution would not be paid that month but would be held over until the following month and added to the incentive fund distribution at that time or until such time that the distribution exceeds 3¢ per hour worked. This was to eliminate the necessity of preparing checks for small amounts.

From this point on it was a simple payroll procedure to compute the gross earnings for the eligible employees, determine the proper deductions and compute net pay. Normally, these incentive checks are ready by approximately the fifteenth of the following month. In addition to distributing the incentive check to the eligible employees on the 15th of each month, a short recapitulation of the calculations is also given to each. From this, the employee can readily see where the problem areas are—and determine where improvement can be made.

Perhaps we should point out at this time that, prior to the establishment of the plan, we held a meeting of the maintenance shop and related personnel to completely explain the principles and procedures of the plan. Everyone was thoroughly briefed. We felt that only through a well-explained and understood plan could real results be attained and continued. Other procedures incorporated in our plan are that—

1. Should an employee be terminated during the month, his share of incentive is mailed to him at the time of distribution.
2. Newly-hired employees are eligible for incentive after the completion of the second full month from hiring date.

The employees understand that the plan is subject to review every six months, with the possibility that the standards or allowances may be changed at those times. However, no changes are made unless conditions have changed materially or unforeseen conditions of a special nature have occurred to make the plan inoperative. This is similar in conception to changes under individual incentive plans. The employees also understand our practice of compiling an annual budget and that our standards or allowances are based on this budget. This has increased the importance of the annual budget and has placed increased emphasis on accuracy and foresight in its preparation.

Incentive Pay — and Control — Move Upward

Our results to date have been extremely encouraging. While the plan had a slow start, with hourly incentive earnings on a low level—around 5¢—they have now moved upward to approximately 18 to 20¢ with increased interest being shown by the maintenance shop and related personnel. Needless to say, our comparison with budget has been excellent. This year to date we are approximately 10 per cent under budget. This has been a boost to the profit picture.

We trust that our success with the plan will continue and that we can coo-

tinue to show reductions in maintenance costs. Like all good incentive plans, however, it will need to be reviewed periodically, and revised if necessary. Perhaps it should be pointed out at this time that, while it generally is considered desirable to be able to measure and pay on the basis of individual effort measured by standard time allowances, it was our opinion that in our maintenance shop area the inherent costs of such a plan would be prohibitive. The necessity of maintaining detailed standards on all the various and sundry tasks or duties would be extremely burdensome, not considering the fact that extra clerical help would be required to handle the necessary record keeping. While our plan is based on a group application, which we recognize might be considered a disadvantage to some, it does have a number of excellent features which we feel more that offset this one possible disadvantage. For example:

1. It ties into the financial figures.
2. It is simple to administer and maintain.
3. It is flexible to cover various situations.
4. It eliminates individual judgment in administration.
5. It is easily understood by all employees.
6. It includes materials and supplies as well as labor costs.

Furthermore, the plan has given the maintenance shop employees an opportunity to earn more money. It has placed them on a par with the direct productive employees. Thus, the plan has been a morale booster. Also, it has been successful in reducing costs which, after all, is probably the main criteria. In addition, the clerical time—including the computation of savings, cents per hour earned, net pay and writing the checks—takes less than one hour per month. This is another outstanding feature.

The superintendent of the maintenance shop heartily approves of the plan. It had become much easier for him to convince his employees that costs need to be reduced. His employees are now cost-conscious. Cooperation among the workers has definitely improved. Suggestions are encouraged by the plan. It recognizes that the maintenance shop personnel are in an excellent position to suggest and recommend changes to keep the production equipment running longer and faster and more efficiently. Preventive maintenance is encouraged. Recommendations and follow-through to increase production, reduce waste, etc., all help to boost the earnings of the maintenance shop personnel. And, after all, who is in a better position to recommend these kinds of changes than the people who must maintain the machines and keep them running—efficiently? In conclusion, we feel that our cost-reduction incentive plan has definite control, with incentive being paid for value received.

Digest of N.A.A. Research Report No. 34

Classification and Coding Techniques to Facilitate Accounting Operations

Presented below is a digest of findings in a new N.A.A. Research Study dealing with classification and coding techniques. Members of the Association who wish a copy of the full report may obtain one copy without charge on request to the National Headquarters Office. A convenient order card will be mailed to you in a few days for this purpose. Copies of the report are also available to non-members at $2.00 per copy. Members may obtain additional copies at the same price.

CLASSIFICATION AND CODING are basic techniques for organizing the factual data needed by management in planning and controlling operations of a business. This study deals with application of classification and coding to data for which the accountant is responsible. Material presented in the report is drawn largely from practices of forty companies that participated in this N.A.A. Research Study by contributing information about their practices and procedures.

Fundamentals of Classification and Coding

The report begins with a review of fundamental concepts and techniques which underlie classification and coding practice. This material is equally applicable where data is processed by simple manual methods or with the aid of advanced mechanical and electronic equipment.

Stress is placed upon first determining the purposes for which accounting data are wanted and what types of information can best serve each of these purposes. These questions need to be answered to make sure that data supplied is relevant to the decisions facing management. Participation by sales, production, and financial personnel is needed in evolving a sound plan. However, the accountant is generally the leader and coordinator in code revision and development.

When purposes have been determined, attention can be turned to techniques

for classification and coding. The report describes the following procedural steps.

1. Precise identification and description of items to be classified and coded.
2. Classification according to characteristics which are significant for the intended purposes.
3. Coding, which consists of assigning symbols according to a systematic plan for distinguishing items and the classifications to which each item belongs.

A variety of coding plans exists. For purposes of discussion in the report, codes are classified according to the kinds of symbols used and the arrangement of these symbols to identify characteristics of the items coded. While letters, numerals, or combinations of letters and numerals are employed in coding accounting data, companies participating in the study show a strong preference for numerical symbols. Wherever possible, symbols should be arranged in some systematic or familiar sequence to assist in interpreting the coded data. Symbols may be arranged in sequence, blocks, or groups. Most codes in use combine features of several different coding plans.

Factors affecting the choice of a coding plan include (1) nature of the data, (2) uses to be made of the coded information in data processing operations and reports, (3) clerical economy in coding, handling, and decoding, and (4) acceptability of the code to company personnel and others who are expected to use it.

Practical Development of Codes

After discussion in general terms, the report turns to practical applications of coding in several fields of information with which the accountant is concerned. Each of these bodies of data present common problems in coding and approaches to these problems are similar in most of the forty companies participating in the study. On the other hand, individual codes differ in detail because products, operations, and other characteristics of the companies differ. In the report, coding practices described are illustrated with numerous examples.

Codes for Accounts

In most of the companies participating in the study, the accounting code contains a number of fields to designate divisions, plants, departments, and other classifications as well as accounts. This reflects the fact that reports of

income, sales, costs, and other items are wanted for subdivisions of the business. Coding of general ledger accounts has been adequately described in accounting literature, but sales and cost analysis codes have received little attention by writers on accounting.

Sales analysis codes are designed to provide analyses of sales by product, geographical area, salesman, customer class, product end-use, and any other categories desired by management in directing a company's sales effort. While certain sales reports are prepared repetitively, the basic sales records are usually coded to facilitate analyses which are prepared only when requested by management. The volume of data is often large and sales analysis codes should be adapted to the mechanized data processing equipment used. In the coding of data from current transactions, precoded master files may be used to effect mechanical coding of data which remains relatively constant. Only information which changes from transaction to transaction needs to be coded manually.

Cost analysis codes display three basic classifications as follows:

1. Responsibility for cost control. Summarization of costs by responsibilities provides data useful in budgeting and control of costs.
2. Source or nature of cost. This information is useful in tracing variances to their sources such as changes in material prices, labor efficiency, etc.
3. Products and other units such as sales territories. Information of this type is needed to determine profitability of various segments of the business and is helpful in establishing selling prices.

Account codes are illustrated with numerous examples from practice.

Codes for Products and Materials

An adequate product code is necessary for sales analysis and for economical handling of customers' orders. A materials code enters into purchasing, production planning, inventory control, and cost accounting functions. The accountant is closely associated with all of these operations and therefore has a vital interest in codes for products and materials.

Identification, description, and classification of products and materials is an essential prerequisite to good codes. In some cases product varieties have grown without control or coordination. Control over variety of materials used is also weak in some companies. Identification and classification of products and materials must be carried out by persons who have a thorough knowledge of the items in question. Substantial savings from elimination of excess variety often accrue as a by-product of code development.

The report presents numerous illustrations of codes for products and materials. These illustrations are taken from practices of companies participating in the study.

Advanced Applications of Coding

The important developments which have occurred in data processing equipment during recent years have stimulated advances in coding techniques. In the final chapter of the report, several of these advanced applications are briefly described. Topics considered are: (1) classifying data by frequency of occurrence to reduce handling time, (2) coding to facilitate access and improve utilization of memory capacity, (3) devising unique checkable identification symbols, and (4) use of codes in integrated data processing operations.

While these techniques originated in using machines, the underlying ideas have usefulness in a broader range of situations.

An appendix to the report presents in case study form an application of coding in the mechanized planning of material requirements.

The Accountant and Society

by KENNETH W. PERRY*

ACCOUNTING TODAY epitomizes the extensive application of the great science of applied mathematics to the world of everyday affairs, and all of society is affected. Among other things, this widening of the uses of accounting data has simultaneously increased the social responsibilities of the accountant. His responsibilities are no longer limited to the stockholders and creditors alone but also include other areas of society.

Administrative and regulatory governmental agencies, and their increasingly extensive and minute control of business operations, underscore the social responsibilities of the accountant. We must be prepared. Currently, in this writer's opinion, additional problems and responsibilities exist in areas such as (1) tax legislation, (2) tax administration, (3) expression of accounting principles in statutes and judicial decisions, and (4) social accounting as such. There is much the accountant can do to better acquaint himself in these areas.

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A Case in Accounting For Sick Leave Pay

by FRANK S. HOWELL

THE WXY CORPORATION is a manufacturer of aircraft components, employing about 6,500 people. Its payroll accounting is handled on punch cards which are processed through a card-input computer with necessary auxiliary equipment. This paper describes the manner in which the company controls and accounts for the accumulation and utilization of paid sick leave by its employees.

Provisions of Sick Leave Agreement

Under a union agreement of several years' standing, hourly workers are entitled to paid sick leave annually, the amount being based on years of service. The agreement provides for the following:

Service	*Annual Vacation*
One to three years	40 hrs.
Three to five years	60 hrs.
Five to ten years	80 hrs.
More than ten years	100 hrs.

Identical privileges are accorded salaried employees below the executive level, as a matter of company policy. Executives may receive up to a full year's salary during periods of illness, after which they are subject to retirement. Under an agreement with the Government, only as much sick leave pay of executives is charged to defense contracts and subcontracts as would be payable if they were covered by the formal sick leave plan.

All hourly and salaried employees are permitted to accrue a "sick leave bank" equivalent to one year's earned sick leave. For example, an employee having between five and ten years of service would be entitled to carry forward from one calendar year to another 80 hours of unused sick leave, which is available for his use in addition to the leave which he will accrue during the year, and which may be carried over for future use if not taken during the current year. Any sick leave not taken and not carried over in the "bank" is forfeited at the end of the calendar year.

The union agreement provides for the acceptance of strict company controls to prevent the use of sick leave as an additional vacation. To receive pay for sick time, employees must notify their immediate supervisors prior to noon on the first day of ab-

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sence. If such absence lasts longer than two days, the employee must present a medical certificate upon his return to work. This certificate is attached to his time card. It is reviewed by the payroll audit section and, if acceptable, is key-punched on the employee's control card. The computer is programmed so that it will not accept a "short period" sick leave pay routine if the card is not punched to indicate an acceptable medical certificate.

The union has joined with the company to prevent abuses of sick leave. The employee's supervisor will notify his shop steward of the employee's sick leave absence. The union employs a nurse to visit members on extended sick leave. Copies of the nurse's report are given the company. They receive the same treatment as medical certificates. Recurrent sick leave absences on the part of hourly employees can be investigated by the company but, ordinarily, the situation is brought to the attention of the union for such action as it deems proper. The company makes independent investigations in the case of salaried employees who appear to be taking advantage of its sick leave policy. Advance sick leave may be granted occasionally to employees of long service and known reliability. This is entirely a mattter of company policy and is not included in the union agreement.

When an hourly employee reports sick, his time card is so marked by his supervisor and, subject to the controls just described, he is entitled to receive his regular pay during the period of sick leave absence until his sick leave accrual is exhausted. Separate checks for sick leave are prepared even when the sick leave has been completed during a regular work week. This simplifies computer programming and avoids the problem of lack of computer capacity. It also provides additional controls for the payroll accounting process. An employee absent after initially reporting illness is presumed to be ill thereafter, subject to a medical certificate or a nurse's report in confirmation, unless or until he advises to the contrary. As a matter of practice, checks for sick leave pay covering periods of 40 hours or more are not mailed to the employee unless the fact that he is actually ill has been firmly established.

How Hours Are Credited (and Debited) to the Sick Leave "Bank"

The master status file serves to control credits to the sick leave bank. An employee's right to accrual of sick leave commences on the first day of the month following the first anniversary of his employment. Each month, therefore, the master status file is up-dated to show the amount of sick leave accrual to which each

employee is entitled. The actual accrual is made in minutes to prevent the difficulties which might be caused in reading in hours plus decimals or fractions. Thus, the sick leave bank of an employee who has served one year will be credited with 200 minutes of sick leave on the first of the month following the initial anniversary of his employment and on the first of each month thereafter until he reaches the next stage, when the accrual increases to 300 minutes per month. The sick leave bank deck is compared with the master status file to eliminate terminated employees and to prepare cards for new additions to the bank, after which the accrued amounts are up-dated by the current month's accruals.

Debits to the sick leave bank and adjustments of prior credits or charges are manually punched from forms prepared by the payroll audit section, to which all information pertaining to active sick leave is routed. These cards serve to reduce, or adjust, the amounts in the sick leave bank. The cards also are used in printing out the sick leave checks due employees.

The up-dated sick leave bank cards are run through monthly to print out on a separate form for each employee the beginning sick leave, converted to hours and minutes, at the time of the last leave record printing, the leave taken and accrued during the intervening four or five pay periods, together with the balance in the sick leave bank at the end of the last pay period covered by the form. This form is attached to the employee's pay check for that period. Sick leave statements are also given with each check following termination of employment and may be issued on an up-to-date basis to any requesting employee upon two days' notice. Card coding assures that no employee will carry in the sick leave bank at the end of the calendar year any more than the maximum sick leave accrual recognizable under the union contract, plus the current year's accrual. A special run wipes out over-accruals in the bank at the year end.

Charging Sick Leave Pay; Adjustment of Reserve Monthly

Paid sick leave time is charged by the computer to a special sick leave overhead account in each department coincident with the print-out of the sick leave check. The computer is so programmed that, if an employee has no credit in his sick leave bank and a card calling for a sick leave check is put through, it will be rejected during processing. When advance sick leave is granted, the number of hours taken becomes an overdraft in the employee's sick leave bank and all subsequent accruals, whether the employee is absent on advance sick leave or has returned to active duty, simply reduce the overdraft.

The gross amounts paid an employee during a period of advanced

sick leave are not treated as expenses but are initially recorded in an account "amounts due from employees for advance sick leave." Credits reducing the number of advanced hours are paralleled by entries reducing the amounts due and charging a special account which is excluded from the overhead for the department in which the employee is working. To simplify computer programming, these entries are made manually. The company has no firm policy for recovery of advance sick leave in the event the employee to whom the advance leave was granted is not able to return to work. In the few instances in which this has occurred, the loss has simply been absorbed and the sick leave bank adjusted through an entry originating in the payroll audit section.

The monthly accrual of sick leave hours for individual employees is not reflected by any corresponding dollar charge through the accounts. However, at the end of each calendar year, the company adjusts an operating "reserve for sick leave payments to employees" (set up out of retained earnings when the sick leave policies were first adopted) to an amount which is equivalent roughly to 40 per cent of the figure developed by extending the accrued hours in each employee's sick leave bank by his regular hourly rate. Company studies have shown that more than 50 per cent of the accruals in the sick leave bank will never be drawn upon under normal circumstances and it is not considered necessary to have the operating reserve equivalent to the full amount of the sick leave accruals expressed in dollars. Adjustments to the reserve are considered simply as year-end adjustments to overhead.

When an employee is laid off by the company, he does not forfeit his accrued sick leave. If at any time thereafter he is called back, his sick leave bank is automatically reinstated. However, the reserve for sick leave payments does not reflect any part of this contingent liability, which is considered too nebulous even for balance sheet foot-noting. If an employee quits voluntarily, he has the privilege of returning within six months and having his previously accrued sick leave reinstated. If he is discharged for cause, he forfeits completely any accrued sick leave which may be to his credit in the sick leave bank.

Vigilance Exercised

The amount of sick leave pay charged to overhead in each department is closely watched by management and special reports and investigations may be called for if the situation warrants. Certain informal sick leave standards, varying from department to department, have been established, and when these standards are not met with a reasonable degree of consistency, the department head is called upon for full explanation.

The controls over the sick leave pay of salaried workers are equally

stringent. Their supervisors are required to render a weekly report of sick leave absences, and these reports form the basis for charging the employee's sick leave bank. An excessive amount of sick leave on the part of any sizable group of salaried workers is subject to management investigation. Separate sick leave checks are not drawn for salaried workers, nor are their paid absences while ill charged to overhead. Consequently, accounting for the sick leave bank is the only accounting here involved. This significantly reduces the strain on the payroll audit section which, in any case, must bear the brunt of a vast amount of detail relating to the administration of this company's sick leave polices.

How to Continue Your Education

by WALTER T. LENT*

EDUCATION is a continuing process. This continuation is accomplished either by additional academic study or by intensive on-the-job training. Both of these imply a learning process which cannot stop if one is to advance or even keep abreast of his vocational pursuits.

After a person has been acquiring on-the-job training for a number of years, he will find that confidence is the foundation for further growth. But this is not all. The accountant must also look toward other things required in a supervisor or management executive. Can he maintain an open mind? Is he constructive in his thinking? Does he tolerate frustration? Does he willingly accept responsibilities and challenges? It is education through daily experience and practice which develops these traits.

The accountant must also keep current. He must continue to learn of the changes in his profession, be acquainted with other professions associated with his business, follow economic and government trends, and develop individual human relationships—all of which tend to develop personality and inspire confidence. To the young this may appear to be a long and slow process but it is usually the path of progress to desired goals.

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Plant Layout Revision — Project Planning and Cost Considerations

by N. L. SCHMEICHEL

SOUND BUSINESS PRACTICE requires that a program such as a revision or an entirely new layout must be budgeted. One reason, of course, is that it takes money to move equipment, remove walls, rewire, reinstall, etc. Generally the controller or treasurer has a limited amount of money available for this purpose. Another reason is that a basic layout program in its respective parts as well as a whole must be evaluated, and the benefits or cost savings, because of adoption or approval, must be considered against the cost of the program as well as the improvements and benefits derived from the changes.

Many an occasion has arisen in which all the visual aids, plans, elaborate three-dimensional layouts, flow diagrams, etc., have not been sufficient to convince the management to make a positive decision. The process of deciding most frequently resolves itself into an evaluation of the proposal in terms of cash outlays and returns on investment. The accounting complications likely to be encountered in developing this phase of the proposal have "assassinated" many a proposal, no matter how practical it may have been from the standpoint of improving the receiving, manufacturing, warehousing or shipping operations.

Two outstanding reasons exist why a sound and practical layout project receives no further consideration at the stage of presentation. One is that the plant layout engineer is usually not sufficiently familiar with accounting techniques to develop the financial data, such as net sales, operating costs, project expenses, etc., so as to be able to highlight the true economic advantages of the proposal. This function is generally placed at the mercy of a less interested individual, namely, the accountant. The other reason is that the accountant is seldom motivated by inclination or training to wade through layout plans and supporting engineering data far enough to gain a practical knowledge of the basic merits of the program from an operation standpoint.

The difficulty of this dilemma seems to lie more heavily on the side of the engineers than on that of the accountant. What few basic accounting procedures

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the engineer needs to know in order to achieve his purpose are not to be compared in magnitude with the amount of knowledge the accountant would have to acquire and add to his own involved sphere for analyzing layout problems. The few accounting principles the engineer needs to add as part of his repertoire will be explained and illustrated. The illustrations used are pulled from several layout projects and are not necessarily a single co-ordinated endeavor. The forms and methods used in preparing this presentation are actual since the main point at issue is one of technique rather than a scrutiny of performance or identity.

One may be assigned the responsibility of revising an entire manufacturing facility or only one segment of it, like the metal shop, heat treating department or storerooms. In any case, the problem is posed of whether to employ continuous one-model production as opposed to a job shop condition, even though the products may be standard catalog items. Even true job shop conditions are not difficult to analyze once the major classifications of products are determined. Since the continuous production line is simpler compared to the job shop, emphasis will be given to the latter or more difficult situation.

Steps Nos. 1 and 2: Production Volume

Step one is to make a product load analysis as shown in Exhibit 1. Most frequently the industrial engineer can determine broad or general group classifications. For example, a material handling equipment manufacturer would have such groups as this: two-wheel hand trucks, drum dollies, skids, pallets, four-wheel stake trucks, four-wheel multiple platform trucks, jacks, tote boxes, cafeteria trucks, etc. In the road building and agricultural implement manufacturing, there would be classifications such as this: self-propelled pulvi-mixer, pull-type mixer, pneumatic impactor, rototillers, rock crushers, spreaders, 1½ and 2 ton rollers, etc. The toy concern could be found to have the following: maps, jigsaw puzzles, pull-type toys, blocks, animated groups, etc. A glass manufacturer could have product types as: plate glass, rolled glass, thermopane, mirrors, shelving, store fronts, etc. A simple continuous process would be exemplified by a manufacturer of lens blanks for optical glass. Everything, re-

SALES FORECAST BY GROUPS

Date_____ Prepared By_____ Sheet)_____ Of_____

Group	Description	Rep. Model	Last Years Production		Predicted	Remarks
			Rep. Model	Total Group	Sales Forecast	

EXHIBIT 1

gardless of the multi-focals needed, still goes through the same basic operations. Therefore, there would be in this instance only one group description.

For each product group description, a typical representative model or type should be selected, generally the one of the group having the largest sale volume, since that alone would indicate it as being representative. Going back to the material handling concern, we find that within the four-wheel stake truck group, there were sizes ranging from 24" width to 48" and lengths from 30" to 72", steel wheels, rubber tired wheels, etc. Yet the 30" x 60" rubber tired model was the most representative, since it outsold the next size by three to one. However, construction-wise all the trucks were basically similar.

In order to assist the sales department in predicting the future requirements for the group as a whole, we always indicate the last year's production of the representative model as well as the group total.

MANUFACTURED PARTS LIST AND ANNUAL REQUIREMENTS

Group No. _____ Group Requirements _____

Date _____ Prepared By _____ Sheet ___ Of ___

Model	Size	Part Name	Part No.	Drawing No.	Pcs. / Unit	Annual Requirement

EXHIBIT 2

Step two, illustrated by Exhibit 2, is the breakdown of a representative model or type into its sub-assemblies and component parts to form the basis for preparing the work route sheet. If orderly and up-to-date bills of material are in the engineering department files on the representative model, they may be used as the means by which the explosion of annual requirements for all assemblies and component parts of the group may be made. In many cases these are not readily available which, of course, creates the necessity for the form illustrated and summarization of parts required.

Steps 3, 4 & 5: Route Sheet, Machine Load Data, and Cross Chart

Step three, shown in Exhibit 3, is the well-known route sheet. They take on many shapes, sizes and forms, but the one used for layouts must have the annual requirements from the component parts list, the usual lot size or release, and consequently the resulting number of setups or releases per year. This can be well placed in the heading of the form. The body and operational routing must have department, operation number, operation, work center, setup times, cycle times. Then there is added an item not found on the customary route sheets, pieces per load from which is obtained the loads per year. Here the

resourcefulness of the engineer must be apparent. By loads is meant unit loads that normally would be handled by a material handler or, as in smaller plants, by the operator himself. This may take on the form of a single or multiple stacks of tote boxes, pallets, skids, etc. The first operation is the movement of stock as raw material from stores, in order to record material movement in loads and distance. As parts change configuration—particularly as metal drawings, stampings and formed up items change from the flat—piece-load capacities drop, with a corresponding increase in loads handled per year. Distance moved is the one-way trip for whatever the unit load may be to the next listed work center or storage area. Codes can be used to indicate movement by conveyor, gravity, elevator or horizontal movement.

Revised layouts generally have their birth from necessity—as a program for better space utilization to avoid a major or costly building program and for the elimination of material movement. Even when it is recognized that a new plant is needed because of expansion needs, the ever-present cost of moving material must be predicted and known. Therefore, the item of distance moved takes on the greatest significance. It is generally most startling to total the column "distance moved" and publish the mileage of a single piece part from raw material stockroom to finish goods stock. This is the original data about travel distances of components and assemblies. Line-by-line expansion of the one-way distance times the loads per year produces the total movement. This is usually interpreted in miles traveled in a plant per year. Since loads should be moved either by mechanical means or conveyor (or even if moved by man-power), this consideration of distance opens a realm of further research for the engineers.

WORK ROUTE SHEET

Date _____ Part Number _____
Model _____ Material Used _____ Part Name _____
Annual Requirements _____ Lot Size _____ Set - Ups/Yr. _____ Sheet _____ Of _____
Prepared By _____ Checked By _____ Posted To Machine Load _____

Dept. No.	Oper. No.	Operation Description	Machine Number	Set Up	Cycle Time	Pieces Per Load	Loads Per Year	Distance Moved 1	Distance Moved 2

EXHIBIT 3

Since most accounting systems have a chart of accounts providing an account for trucking and material handling, one can take this yearly cost from the operating statement of manufacturing costs and determine what the index of cost per mile presently is. This is just as important and should be of as much concern as the review of the miles per gallon obtained from car performance.

Step four, shown in Exhibit 4, is posting the usual machine load data chart for determining requirements and capacities.

MACHINE LOAD CHART

Date _____ Work Center Or Machine Number _____

Work Center or Machine _____ Location _____

Prepared By _____ Checked By _____ Sheet _____ Of _____

Part Number	Oper. No.	Annual Requirement	Set-Ups Per Yr.	Hrs. Per Set - Up	Set - Up Hours Per Year	Cycle Time	Run Time	Loads Per Year	Remarks
No Machines Available									
No. Machines Required/Shift				Total					
						Total Load Hours			

EXHIBIT 4

Step five, illustrated by Exhibit 5, is developing the cross charts for solving the complicated flow patterns and actual machine or work center relationships

CROSS CHART

TO / FROM	1	2	3	4	5	6	Warehouse or Shipping	TOTAL LOADS FROM
Stores	16 349' 48 55 192 707 195 Save Loads 47 x 349' = 1926 1750 1,069,792 630 Feet	Etc.	Etc.					
Machine Work Center				Etc.				
Total Loads To								Loads Distance Total Load and Total Distance

EXHIBIT 5

and, of course, from these the revised layout is developed. This is the quickest way to get total distances moved for the existing layout. The optimum layout is achieved when equipment is arranged so that it is nearest the equipment from which it receives and to which it sends the greatest amount of material. Such an arrangement is designed to keep handling requirements at a minimum. When the final or alternate plans are resolved, one must then go back to the work route sheet and, in the second column headed "distance moved", post the new distances for piece part cost reductions, or else the posting may be to the cross chart for total distances.

The total of all new distances times the previously developed cost index per mile will predict what your material handling under the new arrangement could well be and, by interpolation, predict the savings in material handling on an annual basis. From this stems one of the most effective means for operating cost reductions.

Isolation of Project Costs

These annual savings will have to amortize the cost of making the preparatory studies as well as the expenses incurred, predicted or actual, for making the changes. If the material handling savings will not recover the cash outlay for modifying the layout, the project must be justified on some basis other than cost. So far as possible, all contemplated expenses for a new layout or alternate proposals must be tabulated so that the total cost for each plan is available to management. The tendency in many small plants is to consider layout revision as part of the normal operating expenses without any further separation or identification being made. Depending upon the attitude of management or of the stockholders, there may be some justification for this type of thinking, but it does not permit a complete evaluation of the program.

Preliminary or planning costs is an item that is most likely to be hidden in normal operating or overhead accounts. However, if consultants or other outside help are used, their compensation becomes quite conspicious and it is difficult to contend that they have saved the comparable value in company executive time. It is not practical to try to isolate the time spent by supervisors and other principal personnel in evaluating and appraising various layouts. Nevertheless, any amount of time by personnel specifically assigned to the project should be considered in the final accounting. Included in these expenses should be all costs for preparing the working drawings, specifications and service listings and all other information necessary to make the move. In order to reduce these costs, college and high school students interested in engineering can be used as part-time help to augment personnel. Also, a listing of new equipment should be accounted for. This tabulation must include all expenses of purchasing, delivery and installation of new machines, material handling equipment, benches, shelving and other production accessories needed for the new plan.

In any extensive structural change or if any new construction is involved, it will probably be handled by an outside contractor. This will require the costing of the architectural fees as well as the contract price to the general contractor. Interest charges on new construction, depending on how the project is financed, may be included. Changes in insurance, taxes, outside engineering and legal fees should be included as part of the cost for making the change. Changes in the services and utilities, whether done by plant maintenance personnel or partly or entirely by outside groups, must be detailed and the cost estimated or the work contracted for a given sum. Included must be provisions for disconnecting the machines to be moved and the reconnecting of all services after they are placed in the new location. Frequently, this costs more than moving the equipment itself.

All movement of equipment by the plant personnel must be charged to the moving account—or the job may be let to professional movers on a contract basis. In either case, the cost must be predicted before the presentation date. Many times the most important of the indirect costs is the time spent by the department heads of the company. This is usually a considerable item. In most cases, this is not charged to moving costs. The re-appraisal of a company's facility is a normal management function and one which the department heads should perform periodically. Quite frequently large quantities of supplies and materials are consumed by changeovers. Anything to be specifically used for the contemplated move should be estimated and costed. This applies to the unskilled help within the plant that may be used on the project.

Before-and-After Indices for Evaluation of Results

All the costs outlined above must be considered in the final computation. There is no formula or set rule for calculating amorization. Amortization—the write-off of these costs—should be against cost savings resulting from the plant changes or against a predicted increased production because of the new layouts. If it is found that the direct material handling cost savings are not sufficient to amortize the moving costs within the selected period of time, then certain operating ratios developed under the existing plan, as compared to those under the new plan, can be used to justify these costs. From the coded distances on the work route sheet, the indices of indirect material handling before and after the adoption of the proposal may be developed. The relationship involved is that of a over b when a equals the sum of the distances parts moved automatically from machine to machine without external or direct labor material handling and b is the total distance the parts travel from raw stores. The new layout should reflect a considerable change in this ratio, to which savings can be attributed. The index of gravity utilization can be computed from c over d when c equals the sum of the vertical distances that gravity feed is used in a multi-story building and d is the total vertical gravity and elevator distance that parts move involving either machines or men. To determine the index of floor area loading density, the formula is:

$$I = \frac{(m + 2)\ (n + 2) + t,}{q - (r + u)} \quad \text{where}$$

m = extreme machine length

n = extreme machine width

t = total work area required by an operator

q = total layout floor area

r = total aisle area

u = total floor area occupied by temporary or controlled storage of material or tools and equipment required to modify this material.

These indices for before and after layout changes times occupancy rates will disclose potential savings. These savings may be compared to the cost of $6 to $15 per square foot for new construction, depending upon the type and facilities needed. It is also possible to determine savings realized through the index of aisle space. This is expressed by the formula r over q where

r = the total aisle space.

q = represents total layout area.

Since storage facilities are a big factor, these should also be evaluated. This index is expressed as (s–m) over q where,

s = the total storage area.

m = the total floor area occupied by temporary or controlled storage of material or tools and equipment required to modify this material.

q = the total layout floor area.

A reduction in the index should relieve congestion and the need for plant expansion and is indicative of good planning. Comparisons of the previous and predicted ratio times the occupancy cost charged out by the accountant for storage or warehouse facilities will yield predicted savings.

Finally, the index of storage volume utilization should be determined. This is v over w where—

v = the volume occupied by raw materials or finished goods at the normal maximum level of storage or inventory.

w = the total volume available for storage of raw material and finished goods.

This is another clue for management to appraise the value of changing facility arrangements. All of these ratios, when developed, provide figures which management needs in passing judgment on the economic soundness of the capital or expense expenditure for new or rearranged facilities.

Interpreting Savings in Income Statement Form

As a final review of operations, an analysis should be made using the financial statement for last year placing in an adjacent column figures reflecting the amount by which revised plant layout will increase sales by better delivery and

reduced backlog for the sales department's predicted sales forecast. This comparison will have to be made line by line in some such detail as follows:

Gross sales
Less: returns and discounts _____
freight out _____
Net sales
Material
Labor
Manufacturing expense _____
Cost of sales _____
Gross profit
Selling expenses
Administrative expenses
Depreciation charges
Miscellaneous deductions _____
Total expenses _____
Net profit ═══
Moving expense (first year) _____
Net profit _____
Per cent of profit ═══

This projection for comparison can be extended to following years up to five if the project is not to be amortized prior to the pegged limit of five. A form to use is shown in Exhibit 6. The plant engineer should keep an eye on the figures for deductions from gross profit. Although he seldom deals with these figures as day-to-day activities, he must watch their probable effect on his proposals. The main accounts involved are provision for depreciation and moving expenses.

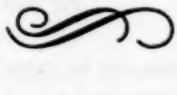
PROJECTED PROFIT FROM LAYOUT PLAN

Date _____

Item Description	Summary For Last Year	Estimated Summary For New Plan	Return on Investment	
			Change Over Last Year	Present Change
Capital Investment Needed For Plan				
First Year of Plan				
NET SALES				
Less: Cost of Sales				
Deductions From Gross Profit				
Moving and Planning Expenses				
NET PROFIT: (Amount)				
NET PROFIT: (Per cent)				
Second Year of Plan				
NET SALES				
Less: Cost of Sales				
Deductions From Gross Profit				
NET PROFIT: (Amount)				
NET PROFIT: (Per cent)				
Fifth Year of Plan				
NET SALES				
Less: Cost of Sales				
Deductions From Gross Profit				
NET PROFIT: (Amount)				
NET PROFIT: (Per cent)				

EXHIBIT 6

Without delving further into accounting detail with which the plant engineer or industrial engineer must eventually become familiar, we have come to the end of our exploration through the financial statement that usually supports any proposal presented to management for consideration. The few accounting estimates and ratios encountered in our discussion are surely not beyond the grasp of an alert engineer who is interested in supplying his "boss" with factual data. The program outlined is designed to provide the plant engineer, the financial manager and top management with the information and data from which the best management decisions can be made.



Policy Considerations in Inventory Valuation

by ALLEN WEISS

IN THE COMMODITY MARKETS of several large cities, prices of many items are set and adjusted by continual interaction of forces of supply and demand. Quite naturally, these materials are noted for instability of price as compared with consumer goods. For those manufacturers whose business consists in processing commodities for sale as consumer goods, the discrepancy in behavior between their raw material purchase prices and their finished goods selling prices raises serious problems of inventory policy and valuation. Bakers and confectioners buying flour, sugar and cocoa; textile concerns buying cotton and wool; coffee roasters and manufacturers of potato chips, to name a few, all find themselves in this predicament.

Operating "Protections" Against Commodity Price Fluctuations

A manufacturer who finds that commodities make up a large part of his inventories can find some protection against adverse price fluctuations by adopting inventory policies that reduce their effects on his profits. Two policies designed to reduce inventory risks are: (1) hedging and (2) holding "cover" to a minimum.

1. Successful hedging demands that price movements in the futures market of a commodity correlate highly with price movements in the spot market. Commodity markets generally exhibit a sufficient degree of parallelism between futures and spot prices to make hedging feasible to a considerable extent. A perfect hedge would result in a constant margin of sales price over cost. A company may elect to pursue a policy of partial hedging, or market conditions may at times be unsuited to hedging, in which cases gross margins may vary. In stabilizing margins, hedging obviously does not attempt to stabilize costs.

2. As an alternative to hedging, a manufacturer can reduce his inventory risk by keeping his inventory and purchase commitments to a

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reasonable minimum. In setting minimum periods of cover, he is limited, however, by such considerations as:

a. Delivery time for raw material.
b. Duration of processes.
c. Packed stock requirements for adequate customer service.

In addition, a fixed minimum-cover period translates into a fluctuating minimum-inventory level on account of variations in short-range sales volume forecasts.

Even without hedging, a manufacturer's margin is protected to some extent by a lag in price movements of the products he sells. Thus, if sales prices lag behind major movements in raw material prices by a period of time equal to his cover period, his margin will be relatively stable. The price leader in an industry may be able to accomplish this type of stability. In that event, the rest of the industry can attain a degree of stability by maintaining cover approximately equal to the lag that experience leads them to expect. Deviations from estimated lag, in addition to minor price fluctuations, will cause variations in margin. In times when poor crops, heavy exports or other factors threaten to create shortages, a manufacturer may decide to lengthen his cover in order to avoid the possibility of embarrassment and extraordinarily high costs. In such a situation he considers minimum risk to be either temporarily undesirable or not equivalent to minimum cover.

While generally accepted management doctrine holds that the best inventory policy for a manufacturer to follow is to avoid risk as much as practicable, sticking to normal activities associated with production and marketing, adherence to this philosophy is not universal. A company that believes its continuing familiarity with market conditions and the high calibre of its management are sufficient to tip the scales in its favor over the long run, may be tempted to adopt buying policies that are openly speculative—lengthening cover in anticipation of advancing prices, and reducing cover when a declining market is forecast. In short, inventory policies vary from conservative attempts at minimizing risks to speculation on a regular basis. The aim of risk-avoidance is the maintenance of relative stability of profit margins, independent of raw material price movements; the goal of speculative policies is greater profit over the long run.

Inventory Valuation and Corporate Profits

Most manufacturers are compelled to carry sizable inventories. As a consequence, the method of evaluation will have a significant effect on reported profits. Important as it is to report profits accurately for the guidance of

management, stockholders, creditors, etc., methods of inventory valuation acquire an even greater significance when viewed in the light of their potential effect on a company's cash position. Traditional cost or market valuation of inventories aggravates the effects of cyclical price movements on reported profits. When business conditions are good and profits are high, prices tend to move upward, causing higher inventory values for equal quantities. The ultimate effect is to inflate profits for years in which they are already high. These inflated profits may be expected to bring pressures for dividends and higher wages. They also raise the base for income tax and bonus calculations. All these things tend to reduce the amount of cash available for operations at the very time when high prices make larger cash reserves most desirable.

Base stock and "lifo" methods of inventory valuation are employed by many companies to reduce the effects of cyclical price movements on their reported profits and to protect their cash position in times of inflation. These methods peg large segments of inventories at prices that remain fixed, thereby gaining a measure of profit stability. It need hardly be said that stability of reported profits gained in this manner is highly desirable.

Inventory Valuation and Product Margins

In order to enhance the usefulness to management of product profit statements, it is important that they reflect operations accurately and that they portray the results of company policies. Thus, if management wants to stabilize brand profit margins and policies are adopted toward that end, an artificial stability should not be imposed on product statements, but an approach to inventory pricing should be taken that is compatible with the company's inventory policy and aims. A few examples may illustrate this point:

1. A company that hedges consistently should reflect in its product margins the profits and losses earned from trading in futures. Transfers of trading gains or losses to brands should be timed so as to provide maximum stability of margins.

2. A price leader whose lag in finished goods sales price behind raw material purchase price movements is equated with its own levels of inventory and commitments, should cost its materials on a first-in first-out basis.

3. Another company, keeping in line with the leader, may want to cost on a "lifo" basis so that deviations between finished goods price lag and material cover will be reflected in changed margins.

4. A company or a division the sales of which are on contracts based on current prices of commodities can best interpret its operations by costing to brands at market prices.

5. A company, the buying policies of which are plainly speculative, may want to keep the results of its trading in futures out of its product statements by using market prices, with or without some lag, for product costing.

6. A management that subscribes to the theory that a certain quantity of stock is a permanent investment, necessary to be kept on hand at all times to remain in business, should consider a base-stock method of costing. A typical base-stock method might include the following procedures:

    a. Maintenance of base quantities at fixed prices.
    b. "Fifo" costing of inventory layers in excess of base stocks.
    c. Valuation of temporary liquidations at prices of materials not yet received ("next-in" or "nifo" pricing).

Although "lifo" is essentially a base-stock method, the term is reserved for procedures that are prescribed or allowed for income tax calculations. Inasmuch as the regulations of the Internal Revenue Service apply to "lifo" calculations for published annual corporate statements only, internal product statements and interim reports may be prepared as the company pleases. A straightforward application of "lifo" in brand statements raises problems caused by costing of liquidations at prices that may be several years old; interim liquidations followed by rebuilding at anachronistic prices accentuate the vagaries of "lifo" costing. The solution to this difficulty may lie in a next-in, first-out adaptation for internal product statements and interim reports, with annual corporate results prepared for publication on a "lifo" basis.

As a matter of fact, a company that employs "lifo" to gain a tax advantage and to protect its cash position may select any one of a number of dual methods of inventory valuation in its financial reporting. For example, as noted above, a price leader or follower may prefer "fifo" for brand costing. If the company's published statements are prepared on a "lifo" basis, an adjustment to "lifo" will have to be recorded. Another company, possibly a manufacturer speculating in inventories, may adopt market price costing to brands and adjust to "lifo" in computing its annual corporate profit. A third company might elect to employ a base-stock and "nifo" basis for its regular brands, a market price basis of costing for contract business, and "lifo" for its corporate reports.

Adjusting to "Lifo" from Special-Purpose Valuations

If a company's over-all profit is reported on a "lifo" basis and its product statements are prepared on some other basis, a disparity is created which may be recorded as a "lifo" adjustment to profit and loss. In order properly to interpret this adjustment, it is helpful to analyze it into three components: price, mix, and inventory level. The following discussion of these components is based on a "lifo" adjustment from "fifo" costing in brand statements to "lifo" valuation for over-all corporate profit determination.

The price component is basic to "lifo" theory, arising as it does from the fact that "lifo" cost of sales runs concurrent with cost of receipts, while "fifo" cost of sales lags behind. In periods of rising prices, this component of the "lifo" adjustment will be a charge against profits, while in periods of declining prices there will be a credit to profit and loss.

The mix factor results from the *combined* effects of:

1. A price differential between raw materials included in a single pool.
2. A change in the relative proportions of these raw materials in the pool.

A pool that is perfectly homogeneous can have no mix effect, but there are also disadvantages in having too many pools. A change in relative proportions of raw materials will cause a company with an excessive number of pools to lose cost layers (presumably at low prices) in some pools while other pools build cost layers purchased in a higher market. Where different grades are carried in a single pool and processing is more costly for the cheaper grades, the mix effect with respect to material cost will be offset by a mix factor for expenses in inventory, provided that these expenses also are carried on a "lifo" basis.

3. Inventory level, or the building or liquidation of "lifo" layers, will affect the "lifo" adjustment because of the difference in prices applied to the increment or decrement under the two methods of valuation in use.

Interpretation of the "lifo" adjustment is made more meaningful when it concentrates on activity (consumption and receipts), past and future, rather than on inventories at a specific date. A complete presentation should include descriptions of market price movements and of company strategy. While interpretation should be presented in terms of consumption, the computations necessary for a proper analysis are rendered simpler and easier when derived

from comparisons of alternative inventory valuations at the beginning and end of a period. Conclusions reached through inventory calculations are, of course, perfectly suited to restatement in terms of cost of sales, because of the close relationship between the two.

Summary

Considerations leading to the adoption of "lifo" inventory valuation are related to cyclical price movements and contemplate profit stabilization, tax savings and protection of cash position. However, these goals are not always compatible with the aim of product margin statements which is a true representation of operating results in the light of company policies. Effects of short-term price fluctuations are an important consideration, particularly when these movements may be rapid and violent. Manufacturers with large inventories of commodities which are converted to consumer items must pay special attention to inventory policies. For them it is imperative that product costing be related to inventory policy.

The dilemma of product costing versus corporate profit determination can be solved by adoption of a dual system of reporting in which corporate profit is computed on a "lifo" basis and product margins are calculated on "fifo," market price, base stock, "nifo," or whatever basis is deemed most appropriate for the company, the product, and the circumstances. Reconciliation between the bases for calculating product margins and corporate profits is effected by a "lifo" adjustment. This adjustment, itself, requires interpretation. The first step in this process is an analysis in terms of price movements, changes in mix, and the building or liquidation of layers. Computations are made from inventory figures for the sake of simplicity, but interpretation is more meaningful if it contemplates activity (receipts and consumption) over a period rather than status at a point in time (inventory).

Shall We Join the Revolution?

by WARREN H. KELLY*

IT BEGINS TO LOOK as though the accounting world is in the midst of a revolution called "direct costing". There have been a goodly number of strong statements made for and against it. As accountants, we have an obligation to do our best to provide methods of recording information which will serve the needs of users. This obligation forces us to look carefully at all developments in the field of accounting and evaluate them in terms of our experience and needs. However, it is most difficult to correctly evaluate a development which arouses as much controversy and disagreement as does direct costing. I believe that we can find our way more clearly if we keep a perspective which a look at history can give us.

Many years ago—over one-hundred actually—accountants and other persons were concerned about the cost information which was available to them. It seemed to be insufficient for their needs. So a great many people set about to improve their cost information, and absorption or total costing was created. There were many different techniques developed. There was (and still is) much discussion of normal factory production rates, break-even charts, under-absorbed burden, allocations to service departments, average factory production, standard rates, flexible budgets, variable costs, fixed costs, unknown costs, profit planning, etc. All these devices were the result of hundreds of people trying to find a better way to solve their cost problems. All were ideas or plans or schemes the better to answer the ever-increasing pressures of management on the accountant, particularly the cost and industrial accountant, for more and better information. As companies grew more complex, so did the problems—and therefore more difficult to solve.

A few companies in those times developed their own particular "direct costing" methods and quietly applied them to their problems. In recent years the evolution of costing techniques has progressed at a rapid rate but none can match the dramatic increase of interest in direct costing. Its rapid rise in popularity cannot be described with the word evolution. The enthusiastic supporters have been

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loud and vehement; dissenters have been shouted down. It appears that it has become "popular" to champion direct costing, just as it has been "popular" to champion electronics in accounting during this same period.

But popularity is not a sound test. Whenever an idea (not a new idea necessarily, which direct costing certainly is not) receives the publicity that direct costing has received, some rules must be formulated to protect people from flocking to embrace it, frequently with disastrous results. Here is just a set of rules:

1. Do not believe that direct cost-will eliminate work on the part of the accountant. It does not eliminate the necessity of allocations and burden rates.
2. Do not turn to direct costing to get rid of a difficult allocation problem.
3. The use of variable and fixed cost concepts with flexible budgets does not require a direct cost system. Do not use direct costing only to get these—they do not come automatically under any accounting concept.
4. Never underestimate the ability of nonaccounting management to understand accounting terms. Some arguments for direct costing are based on such underestimates.
5. Do not neglect the requirement for total costs over the "long-pull". Direct costing "misses the boat" here.
6. Do not expect direct costing to solve all of the cost problems you have. No one system can possibly do this, and no one chart of accounts.
7. Do not neglect the effect that "pure" direct costing would have on the financial statements. Many people outside the company may make use of these statements.
8. Give management the information it needs to run the business. Do not worry about the name of the system used to do this. If management is satisfied with its information and does not require additional information, the cost system is adequate (and most improbable).

If you have considered using direct costing as a new method in your operation, remember to consider these points. After you have considered them, do not move until you are sure (or as nearly sure as you can be) that you know what your individual management wants and understands in the way of information. Then, after such an analysis, if you still think direct costing is the answer, adopt it, confident that so far as your situation is concerned, this adoption is a part of the evolutionary development of the organization's accounting structure and not a revolutionary new idea which may or may not be suitable to your particular needs.

Isolating Re-Work Costs — A Procedure

by GEORGE A. FENNER

A REPEATING DISCREPANCY between the book inventory and the year-end physical inventory figures led our staff to several studies of operations and procedures. One phase of this review dealt with factory charges to labor inventory. Each year the labor portion appeared considerably lower than that recorded through the books during the year. As the then supervisor of the cost department, it became my assignment to attempt to determine the cause of this overvaluation of the book inventory and to suggest an accounting procedure to correct the situation. Investigation disclosed that one source of this labor variation appeared to be the handling of re-work labor which, in many cases, had been charged as direct labor into the book inventory. This article sets forth the findings from this phase of our investigation of operations and describes the new procedure which was installed to attempt to relieve this situation and to improve our control on re-work labor charges.

"The Cost Accountants' Handbook," (Theodore Lang, Editor, Ronald Press Company, 1944, Page 866) states that work condemned by inspectors as not up to specification may sometimes be reclaimed. In such cases, time tickets made out for workers engaged in repair work on product are stamped "repairs" or "rework" and these tickets should be of a color that distinguishes them from the regular time tickets for good work, so that the labor cost of repairs can be readily identified in the cost department and so that the quantities involved are not counted twice.

Three Occasions for Re-Work

Re-work labor may be incurred in one of three ways: by an engineering change in the design of the part being manufactured, by the operator who is working on the part, and by the operators who are assembling the final product.

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Occasions frequently arise in which the engineering department has cause to change the design of a part and this results in a new blue-print being issued to all department heads concerned. If the part in question is in the process of manufacture, the production control department must stop work on it and determine whether or not it is to be scrapped or can be re-worked to the new design. If the part can be re-worked, a "re-work ticket" is attached to the production lot and states the account number which should be charged for the re-work labor. Once a part has been re-worked to the point of meeting the requirements of the new design, it may then go back into the regular production sequence.

Under manufacturing conditions, an operator frequently does only one operation on a given part and then the work progresses to another machine for a different type of operation by a second operator. In order to control quality, inspectors must sample test or completely inspect all parts between these operations. When the sample test inspection or the complete inspection indicates that the parts do not meet the specifications, the full lot is immediately set aside and tagged by the inspector for a review. The salvage department foreman determines which parts can be re-worked to bring them back to meet specifications and has a re-work ticket issued authorizing the work to be scheduled for corrective operations. Parts may be returned to the regular production sequence after they have been re-worked and brought back to the specifications of the original print.

The third stage at which re-work problems arise occurs in the final assembly departments. Here a problem frequently comes from a build-up of tolerances rather from a defective piece of workmanship. This means that each particular part may have been built within its required tolerance but that, if each part had a plus tolerance or if each part had a minus tolerance, the build-up may accumulate to a point where these parts will not properly assemble into the completed unit. This necessitates a disassembly and re-work or adjustment for the parts which do not fit properly. The disassembly of the units and the re-assembly with better units having compensating tolerances is completely a re-work charge, though not the fault of any one department. A special assembly expense account can be established to cover this type of charge.

The Old System — And the New

Due to the lack of control on re-work orders both in the factory and in the

office, our previous system for accounting for re-work arising in the three ways just described was considered to be an inadequate one. Only one re-work ticket (Exhibit 1) was required to be made out and this easily could become lost, with the result that the part was then re-machined as a regular operation, the charge going as direct labor into inventory. Machine operators could also perform the re-work as a direct labor operation to get credit for incentive pay and a less-than-conscientious foreman could let the direct charge go through rather than have his department receive the expense charges for re-work. The prior system required no re-work ticket at all in the final assembly stage. The disassembly by itself would always be charged as re-work but the lack of identification for the parts to be reassembled as a result of these re-work situations often resulted in direct labor charges which increased our inventory book figure.

RE-WORK (Old Form)
X MANUFACTURING CO.

Part No.
Part Name
Quantity
Shop Order No.
Reason
Operation No.
Rework Asst. No.
Rejected by Date
Route To
Date Reworked Reworked By

EXHIBIT 1

In order that better control of re-work be established, an order form in quadruplicate has been designed and placed in use in the factory (Exhibit 2). Each inspector has a pad of these forms with a copy of instructions for his use. It is the inspector's responsibility to fill in the ticket properly, giving all details as to the part number, name, the quantity of pieces to be re-worked, the last operation finished before the re-working, the department responsible for the defect, and the re-work labor account to be charged. The original part of the form stays with the work as an instruction to the foreman and workman; the second copy goes to the plant superintendent; the third copy goes to the foreman in the department responsible for the original work; and the fourth copy goes to the payroll department. When an operator is assigned to the re-work, the order is his authority for ringing on and ringing off that particular job. Each operator must enter the quantity of pieces re-worked, as well as the clock rings giving the elapsed time, in order that an accumulation of units may be verified. When the re-work order is completed, the copy goes to the production control department

RE-WORK ORDER (New Form)
X MANUFACTURING CO.

Order No. Charge Acct.
Date Dept. No.
Part No. Part Name
Quantity Last Operation Finished
Production Order
Reason for Rejection
Rejected by
Dept. at fault Operation No.
Re-worked by Date Quantity
Reinspected by Date Quantity
Quantity spoiled Disposition

EXHIBIT 2

to bring its records up to date and to inform it that these particlar units are again ready to proceed through the production cycle. This copy goes from the production control department to the cost department in order that the time spent may be properly charged to the department responsible for the defective workmanship. After the cost department has made its entries, the original form continues its routing back to the foreman of the responsible department to tell him this charge has now been completed and the work on the units in question has been performed.

The production control department originates the re-work orders for changes resulting from engineering design changes and the same procedure is followed as described above, except that the appropriate engineering account is used rather than a departmental designation.

Inspectors in the final assembly departments follow this same procedure when making out re-work orders in any case where parts are rejected due to poor workmanship, and particularly where such workmanship can be traced to a particular department. The re-work order designates the particular department as being responsible and subject to the charge for time to re-work the parts. Many cases arise in assembly where no defective workmanship exists and where the tolerance build-up is such that the assembly cannot easily be completed. Under these circumstances, the final assembly re-work account number will be used and there will be no other department charge entered.

Better Control on Several Fronts

The use of a multiple form of the re-work order definitely established a better accounting control. Routing a copy of the order to the plant superintendent makes him immediately aware of production troubles and able to take the necessary steps to see that the causes are determined and eliminated early in the production cycle. The copy routed to the production control department enables it to keep a more accurate check on work being performed and puts it in a position to account for shortages at the end of the production run and to anticipate scheduling to replace such shortages. Finally, the cost department is now more capable of classifying re-work labor and to see that charges to this type of work are treated as an expense and do not get into our inventory account. It is definitely our opinion that this relatively simple improvement in the forms for controlling the records of re-work labor has contributed to better control and reduction of inventory errors.

A Case in Measurement of Productivity Changes

by PAUL N. HERRMANN

THE MAJOR OBJECTIVE of any commercial enterprise is to generate as large a profit as it possibly can in performing the operations of its business. Management of these enterprises is thus judged on the results obtained from the profit statement which reflects the financial efficiency of the company's operations. Since, in inflationary or deflationary periods, dollar values change, the change in net profit from one period to another does not always reflect the change in the *physical* efficiency of the operations. Since none of us can reasonably forecast any dollar value changes, it has been argued that the real criteria in judging the performance of any manufacturing operation should be based on some measure of physical efficiency or productivity. Simply defined, productivity is output obtained for any given input.

Suggested Measures of Productivity

A variety of techniques have been suggested to measure the productivity of an individual firm. Among these suggested techniques are.

1. Output per man-hour[1]
2. Output per man-hour and kilowatt-hour[2]
3. Output per man and machine expressed in manpower equivalents[3]
4. Value added per the wage dollar paid.[4]

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[1] "Trends in Output per Man-Hour and Man-Hours per Unit of Output-Manufacturing, 1939-1953," *B.L.S. Report No. 100*, Bureau of Labor Statistics, U. S. Department of Labor, 1955.

[2] "Accounting for Productivity Changes," Harry Ernst, *Harvard Business Review*, May-June 1956, pp. 109-121.

[3] "An Experiment in Productivity Measurement," William Langenberg, *N.A.C.A. Bulletin*, Section 1, January 1952, pp. 584-595.

[4] "Economic and Financial Aspects of Productivity Measurement," Allen Rucker, *Commercial and Financial Chronicle*, July 28, 1958, p. 6. ff.

However, all of the above measures of productivity consider output as a function of one or two inputs. In actual experience, one realizes that changes in output per man-hour or machine-hour are brought about by a variety of reasons influenced by all the factors of input, thus each accounting for a share of the productivity change. It would appear, then, that the ideal productivity measure would recognize each of these inputs in computing a measure of efficiency. A measure of productivity has been devised that will answer most of the objections which have been raised about other measures of productivity for an individual firm. This measure of productivity is the end result of "productivity accounting."[5]

In its basic concept, "productivity accounting" measures the *real* changes in a company's operation by evaluating output (sales) and input (cost of sales, operating and non-operating expenses) in terms of constant dollars. In the remainder of this article, an example is given of how this concept was implemented to solve the particular problem of an individual company.

The Company — Its Operations and Its Problems

In a hypothetical Corporation, which we shall designate The X Manufacturing company, over 100 different chemical specialty products are produced for home and industrial use. Since the amount of processing required to bring the products to market is relatively simple, the largest item of manufacturing cost for any of the products is raw material and packaging supplies costs. The manufacturing expenses ordinarily run about 15 percent of the total cost of goods produced. The operations within the manufacturing area are highly mechanized, with hourly labor accounting for only about 50 per cent of the manufacturing expense and about 7 per cent of the cost of goods manufactured. The manufacturing operations are physically and financially segregated from the rest of the company, which provides relatively reliable cost data for the manufacturing operation alone. These operations consist not only of the manufacture, filling and packaging of the goods produced but also consists of the storage and shipment of the finished goods from the central warehouse.

In costing its products, the company uses the full absorption standard cost system. In this system, all of the manufacturing expenses are allocated to the products produced, based upon pre-determined engineering standards for the

[5] *Productivity Accounting*, Hiram S. Davis, University of Pennsylvania Press, 1955, p. 194.

manufacture, filling and packaging of the products. The bases for these allocations to the products are direct labor hours, weight of the product, gallonage of the product and a variety of other factors. Naturally, at the end of the year, because of the variations between budgeted and actual manufacturing expenses, there will occur either over-or-under-absorption of production expense. This is charged or credited back to the product, based on the amount of burden each of the products had absorbed by year's end. The standard costs of the raw materials and packaging supplies are determined by the purchasing department, based on the average purchase price anticipated from month to month for the enusing period. Adjustments are made to the cost of sales of these products to reflect any price or usage variance which might occur which has not been provided for in the standard cost of the product.

The X Manufacturing Company, in examining its records over the past few years, was concerned to find that, in the face of rising sales, the gross profit margin was shrinking. In investigating this more thoroughly for the years 1956 and 1957, it was found that sales on the company's own manufactured goods had increased 10 per cent while cost of sales on these products had increased 12 per cent. In examining cost of sales by each of its components (raw materials, packaging supplies and burden), the company found that the burden expressed as a per cent of the goods manufactured remained relatively stable. This seemed to indicate that the rise in cost of sales was due chiefly to the rising costs of raw materials and packaging supplies. But, in a closer examination of burden between 1956 and 1957, it was found that these costs increased in dollars an amazing 6.5 per cent, which certainly seemed excessive considering that a large element of the manufacturing expense was fixed. The company began to search for a logical explanation of these rising costs.

Adopting the Measurement Basis Selected

In reviewing some of the measures of productivity which have been used to measure the productivity change of an individual firm, the company was looking for one which would explain the gradual reduction of its gross profit margin. The plan which appeared tailored to fit the requirements was the plan outlined by Davis, which reflects productivity as output per dollar of input. But, since the Davis plan encompasses the measurement of all the facets of business operations, while Company X was concerned only in determining the efficiency

of the manufacturing operations, minor changes had to be made to the plan. It was decided to:

1. Establish 1956 as the base year from which the productive effort of Company X for 1957 would be compared.
2. Since 1956 would be the base year for comparisons, all output and input would be valued in terms of 1956 prices.
3. Revaluation of prices would be done wherever possible by re-pricing, that is, the revaluation of specific quantities of output and input by prices prevailing during the base period. The index method of revaluation would be used when one price or price index was representative of the items to be revalued.

Determination of Output

By definition, output is the value of all finished goods produced. The full absorption standard cost system employed by the X Manufacturing Company to cost its production proved a valuable tool in measuring output. In the base year, the total standard cost of all finished goods produced (adjusted to actual by periodic changes for material and burden variances) exactly equaled the inputs of materials and manufacturing expenses consumed to make those goods. Then, in 1956, with outputs and inputs valued in 1956 prices, the productivity of Company X would be one, since productivity is output obtained for any given input. In 1956, for every dollar spent in the manufacture of finished goods, a dollar's worth of finished goods value was produced for inventory. The problem, however, lay in the revaluation of the 1957 output in terms of 1956 costs, especially since about 5 per cent of the output in 1957 consisted of new products manufactured first in that year.

Although company accounting records provided a dollar value for the actual cost of goods manufactured by Company X alone for each year, it was necessary to extend the production volumes in 1956 and 1957 by the standard costs (adjusted) prevailing in 1956. The remaining production of 1957, which consisted of new products, was analyzed individually by product. Based on material prices existing in 1956 and burden rates on similar products produced in 1956, an approximate cost in 1956 prices was determined for all of the new products produced during 1957. It was admitted that the revaluation of new products for 1957 was an approximate one, but it was felt that this approximation was relatively accurate in view of the fact that none of the new products required a significant change from the normal manufacturing operation. The results obtained reflected what the cost of 1957 production would

have cost in 1956. A summary of the results obtained in calculating output in 1956 and 1957 appears below:

Analysis of Output
(000 omitted)

	1956 Output	1957 Output at 1956 Prices	1957 Prices	Per cent increase in output Total	Price	Production Increase
Product 1	$15,641	$16,129	$16,692	6.7	3.5	3.2
Product 2	2,177	2,210	2,346	7.7	6.1	1.6
Product 3	649	654	685	5.6	4.7	.9
Product 4	396	377	401	1.3	6.4	(4.8)
Total	$18,863	$19,370	$20,124	6.7	3.9	2.8

From an examination of this table, one of the questions raised by the management of Company X can be partly answered. It is apparent that the cost of all production increased 6.7 per cent during 1957, with the costs of production accounting for 3.9 per cent and *real* increases in production accounting for only 2.8 per cent. Rising production costs, then, without corresponding increases in selling prices, were responsible for the reduction 1957 of the gross profit margin. The problem now was to find which of the various factors making up cost of sales was chiefly responsible. If the increase was in raw materials or packaging supplies, the research and purchasing departments should be made aware of this situation with an eye to reducing costs through re-formulation or substitute materials. If manufacturing costs were increasing, then the production department should be made aware of these facts in order that productivity could be increased. These observations, of course, could not be made until the various factors of input were analyzed.

DETERMINATION OF INPUTS

Raw Materials, Supplies, Labor

The valuation of raw materials in production was computed on the basis of the actual average inventory value. In surveying the various raw materials entering into the 100 assorted products of the company, it was apparent that, although the products differed widely in use, there was considerable usage of the same raw material in most of the volume products. Since 1957 usage had to be revalued at 1956 prices, a listing was made of the important raw materials. This list included about 70 per cent of the tolal value of all raw materials used in production. 1957 usage was then extended by the actual average price pre-

vailing in 1956 in determining the 1957 input of raw materials at 1956 prices. The remaining 30 per cent of the materials used in the 1957 production was revalued using the Department of Commerce Wholesale Price Index for industrial chemicals. The actual unadjusted dollar value of raw materials for production for 1956 and 1957 was secured from accounting information available in the company.

The following table summarizes the effect that price changes of certain raw materials had on the valuation of the total raw material input:

Raw Material Input 1956 and 1957
(000 omitted)

Raw Material	Usage '56 @ '57 Prices	Usage in 1957 @ '56 Prices	Usage in 1957 @ '57 Prices	Increase (Decreased) in 1957 Total	Increase (Decreased) in 1957 Price	Increase (Decreased) in 1957 Usage
A	$2,117	$2,216	$2,104	(13)	(112)	99
B	1,450	1,435	1,468	18	33	(15)
C	649	535	547	(102)	12	(114)
D	601	575	553	(48)	(22)	(26)
E	406	396	391	(15)	(5)	(10)
All others	3,285	3,493	3,580	295	87	208
Total	$8,508	$8,650	$8,643	135	(7)	142

It will be seen that Company X paid $135,000 more for its raw materials used in 1957 production but this actually represented an increased usage of $142,000 over the 1956 level, since price reductions on three of the larger raw materials resulted in a net savings to the company of $7,000. Again, this schedule above, drawn from calculations made in determining productivity, provides management with an excellent by-product, which reveals the importance of raw material price changes and indicates shifts of usage among raw materials. This information provides management with a picture of internal operations which normal accounting information fails to furnish.

The actual value of packaging supplies used in production for the 1956 and 1957 years was available from accounting records within the company. The problem of revaluing 1957 usage at 1956 prices was more difficult to solve than the revaluation of raw materials, since the variety of packaging supplies was so great. An internal packaging price index was constructed for the two years covered, by taking monthly average costs of selected packaging components. These costs were then weighted by the relative importance of the type of packaging component they represented and a monthly internal

composite packaging index was constructed. The index showed price increases of 7.7 per cent during the first year and 6.3 per cent in 1957.

As anticipated, the easiest input to determine was hourly labor, since the company tabulates monthly manufacturing hours worked and total wages paid. However, to these wages were added the so-called fringe benefits of labor, such as social security, pensions, and health, accident and unemployment insurance. An average hourly rate was determined for each year by dividing total wages and fringe benefits by hours worked. Then 1957 hours were extended by the 1956 average hourly rate to determine what the wage payment would have been in 1957 if wages and fringe benefits had remained at the 1956 level. For the two years, it was found that total wages and benefits had increased 8.6 per cent while hours worked increased only 0.4 per cent.

Depreciation

Of all the manufacturing expenses to revalue, the most difficult to measure is depreciation. Depreciation expense is a financial recognition that part of a capital asset has been consumed in producing the years' output. Since these estimates have been based on the anticipated life of the asset (usually), it is most difficult to convert the total depreciation dollars to common dollar values in the same way as with other input values. Consider the depreciation dollars charged in the base year, which are a mixture of dollar values from the base year on assets purchased that year, and varying dollar values for prior years depending upon the value of the dollar in the year in which the asset was purchased. Another factor affecting depreciation expense as reflected on the books of Company X was that a portion of this expense consisted of accelerated depreciation. In reality, this is an accrual of expense on equipment, which will be used in some future period but is charged to the current year's operations.

In order to value Company X's depreciation in the same terms as the other factors of input, presented through example in Exhibit 1, the following steps were taken:

1. A listing of all asset additions for the manufacturing division was made, extending back to 1952. Company records provided a breakdown by type of asset purchased in each of these years, i.e., building, building improvement, machinery and equipment, land improvement, etc.
2. A weighted price index was constructed based on the construction cost index—brick and steel and the electrical machinery

CALCULATION OF ANNUAL INPUT OF CAPITAL GOODS IN BASE YEAR PRICES COMPUTED FROM ADDITIONS TO PLANT AND EQUIPMENT

A. At 1956 Prices

Year Addition Made	Cost Value in Actual Prices	Price Index	Cost Value in 1956 Prices	Value Used from Acquisition to '56 in '56 Prices	Value Left 1/1/56@ '56 Prices	1956 Rate Used	Value Used in 1956 Prices	Value Left 1/1/57 @ '56 Prices	1957 Rate Used	Value Used in 1957 @ '56 Prices	Value Left 1/1/58 @ '56 Prices
Prior to 1952	3,774	70.2	5,377	1,604	3,773	6.18	332	3,441	6.23	335	3,106
1952	176	83.8	210	39	171	6.18	13	158	6.23	13	145
1953	863	88.5	975	122	857	6.18	60	797	6.23	61	736
1954	365	89.7	408	25	383	6.18	25	358	6.23	25	333
1955	1,560	94.4	1,652	--	1,652	6.18	102	1,550	6.23	103	1,447
1956	352	100.0	352	--	--	--	--	352	6.23	22	330
1957	242	104.4	232	--	--	--	--	--	--	--	232
Totals	7,332		9,206	1,790	6,836		532			559	

B. At 1957 Prices

			Cost Value in 1957 Prices	Value Used from Acquisition to '56 in '57 Prices	Value Left 1/1/56 @ '57 Prices		Value Used in 1957 Prices	Value Left 1/1/57 '57 Prices		Value Used in 1957 @ '57 Prices	Value Left 1/1/58 '57 Prices
Prior to 1952	3,774	67.2	5,616	1,676	3,940	6.18	347	3,593	6.23	350	3,243
1952	176	80.3	219	41	178	6.18	14	164	6.23	14	150
1953	863	84.8	1,018	126	892	6.18	63	829	6.23	63	766
1954	365	85.9	425	26	399	6.18	26	373	6.23	26	347
1955	1,560	90.4	1,726	--	1,726	6.18	107	1,619	6.23	108	1,511
1956	352	95.8	367	--	--	--	--	367	6.23	23	344
1957	242	100.0	242	--	--	--	--	--	--	--	242
Totals	7,332		9,613	1,869	7,135		557			584	

EXHIBIT 1

equipment cost index, as reported in the *Survey of Current Business,* U. S. Department of Commerce. The weight determinant was based on the percentage of building-type assets and machinery-type assets on hand each year. It was assumed that the total manufacturing assets prior to 1952 consisted of an equal per cent of building and machinery.

3. The weighted price index, with 1956 as a base, was used to inflate the cost value of the asset additions to 1956 prices.

4. It was then assumed that normal depreciation rates accurately portray true asset life. The average rates of depreciation normally charged annually by Company X for each of its classes of manufacturing assets were:

Asset Class	*Rate of depreciation*	*Asset life*
Land improvements	5.0%	20 years
Building equipment	7.0%	14.3 years
Machinery equipment	7.5%	13.3 years
Factory office equipment	7.3%	13.7 years
Building improvements	10.2%	9.8 years
Factory buildings	3.2%	31.3 years

These rates of depreciation were extended by the per cent of total assets each asset represented, and totaled to give a weighted rate of use for each year. For assets on hand at the beginning of 1952, it was assumed that about 30 per cent had been depreciated, since 58 per cent had been acquired since 1941 and 24 per cent since 1948.

5. The weighted rate of depreciation was extended by the total assets on hand at the beginning of each year from 1952-1955, which resulted in the determination of the value used from date of acquisition to 1956 in 1956 prices.

6. The value computed in Step 5 was subtracted from the inflated cost value of the asset in 1956 prices, which showed the asset value remaining on January 1, 1956.

7. The asset value remaining each year was extended by the rate of asset usage for 1956, 6.18 per cent, which reflected the total asset depletion (depreciation) for 1956.

8. The depreciation expense for 1956 was subtracted from the value of assets on hand at the beginning of 1956 and was added to the value of assets purchased in 1956 to indicate the value of assets on hand at January 1, 1957.

9. Step 7 was repeated for 1957 to determine depreciation for that year.

10. In order to determine what the depreciation expense would have been, using the same system in 1957 at 1957 prices, Steps 1-9 were repeated, with the price index reflecting 1957 as a base year.

Other Inputs

Investors' return for replacement of capital equipment is the difference between the depreciation actually charged during the year and the amount of depreciation computed for productivity analysis. It represents the amount of depreciation that has been accrued from the year's operations. Theoretically, as assets are completely depreciated financially by using accelerated rates, actual depreciation will become less than computed productivity depreciation, and this return for replacement must then be applied against that year's operations.

The input value of management consisted of the salaries paid to the manufacturing executives, their staff, and the specially-trained technicians (engineers) who provided services to the manufacturing operations. Revaluation of the management input of 1957 in terms of 1956 prices was determined by extending the average salary paid to the management group by the average number in that group in 1957. It is suspected that this measure is, at best, a rough estimate of the management input in any given year because of the wide variances occurring in this type of loose averaging. But, since more detailed information on this factor was not readily available, the value will have to be used with reservations.

The expenses of some 30 items were collected as input value of supplies and services. These expenses ranged from maintenance and office supplies, to fuel, to inventory taxes, to the cost of public utilities (gas, electricity and water) and to assorted other charges. These expenses in 1957 were revalued to 1956 prices by using the U.S. Department of Commerce Wholesale Price Index as the deflator. Although it could be argued that a better basis could be found to revalue these expenses if they had been segregated down to their actual types of expense, it was felt that the size of any one expense item did not, at this time, warrant further consideration in revaluation. All that was required was a recognition that these expenses were generally lower in 1956. If a further analysis is required, revaluation by re-pricing the largest expense items by 1956 rates extended by 1957 usage could be accomplished with a minimum of difficulty.

An Analysis of the Productivity Statement

The output values and input values are now assembled and a productivity measure is computed as illustrated on the Productivity Statement (Exhibit 2). The statement, as illustrated, reveals all the information that the members of Company X require to answer the questions they raised about manufacturing operations in 1957. It can be seen that the total value of production increased 6.7 per cent ($20,130 divided by $18,863) during 1957. However, only 40 per cent of this increase ($507) represented tangible production increases, while cost increases of $760 accounted for the remaining increase in production value. The suppliers of input accounted for 91 per cent of this synthetic rise in production value in 1957 ($694 divided by $760) with the suppliers of packing components and the production hourly workers receiving the largest share of the increase. The remaining 9 per cent of this rise in production value was the result of a drop in productivity in 1957. To answer management's question specifically, the drop in the gross profit margin on goods manufactured in their own plant in 1957 over 1956 was due chiefly to rising prices of packaging supplies and the increasing costs of labor (88.7 per cent) and a drop in productivity of 0.3 per cent per dollar of input.

It is admitted that the above measures relating to the productivity of Company X are only approximations of the manufacturing activity for the company but with further refinements (if desired) in the technique described, it is my belief that the company will have meaningful indicators of productivity which normal account statements fail to show.

THE PRODUCTIVITY STATEMENT

(The X Manufacturing Company - 1956 and 1957 (000 Omitted)

	1956	1957		Increase	
	@ 1956 Prices (1)	@ 1956 Prices (2)	@ 1957 Prices (3)	Due to Price Change (3-2)	% Distribution
Output					
Product 1	$ 15,641	$16,129	$16,698	$569	84.8
Product 2	2,177	2,210	2,346	136	17.9
Product 3	649	654	685	31	4.1
Product 4	396	377	401	24	4.2
Total	$18,863	$19,370	$20,130	$760	100.0
Input					
Raw Materials	$ 8,508	$ 8,650	$ 8,643	$ (7)	(1.0)
Packaging Supplies	6,714	7,138	7,617	479	69.0
Hourly Labor	1,673	1,680	1,817	137	19.7
Depreciation	532	559	584	25	3.6
Investors Return	76	41	16	(25)	(3.6)
Management	686	654	722	68	9.8
Supplies and Services	674	714	731	17	2.5
Total	$18,863	$19,436	$20,130	$694	100.0
			Decrease	Loss in Productivity	
Output per Dollar Input	1.0000	.9966	.0034	$66. - * (.0034 x 19,436)*	

EXHIBIT 2

Standard Cost Accounting For Returnable Shipping Containers

by E. E. BARTH

IT IS THE PURPOSE OF THIS ARTICLE to discuss procedures used by a small to medium-size manufacturing company in accounting for returnable containers in the hands of customers, as well as the same type of containers located on its premises. The system was designed to accomplish results with a minimum of effort and expense and still reflect reasonable values acceptable for financial statements and income tax purposes. It has been applied to wire and cable reels for several years, with only minor adjustments, and we believe that, with only slight revisions, it can be applied to any business which is faced with the problem of accounting for returnable containers.

The problem can be broken down into three elements, which are:

1. Purchase or acquisition.
2. Transfers from manufacturer to customers and return to manufacturer during the useful life of the container.
3. Disposal of the container through scrapping or sale.

By discussing each of these periods during the life of a container, we can cover the complete accounting cycle.

Acquisition of Containers

At the outset, since there were so many sizes and types of returnable containers, it was decided to group into classes those of a homogeneous nature and falling into an approximate price range. Each class was given a standard cost based on the average purchase price within the class, and this standard remains the same from year to year. As subsequent classes are added, the same basis is used for setting standard costs. Since many returnable containers have a high unit value and a life expectancy beyond three years' classes of containers are considered as fixed assets and subjected to normal depreciation procedures. A subsidiary plant asset ledger is maintained for them. The estimated life expectancy assigned to each class is based on an agreement with Internal Revenue agents and a study made by stenciling the acquisition date on the

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containers and tabulating the known disposals.

The accounting entries to bring returnable containers on to the records are as follows:

Dr. Returnable containers—Standard cost (in plant)

Dr. Returnable containers — cost variance

Cr. Accounts payable.

A current worksheet setting forth the life expectancy, is maintained for all purchased containers and is summarized monthly. At the end of the year, one entry is made in the fixed asset ledger by life expectancy for all purchases during the year. The cost variance is capitalized pro rata.

Flow of Containers to and From Customers

To arrive at schedules of values to be used as deposit requirements by customers for returnable containers, first consideration was given to trade practice. This was adjusted, where necessary, to arrive at a factor above cost to induce the customer to return the containers promptly, thereby preventing excessive investment in returnable containers.

Another prerequisite to shipping returnable containers to customers is found in the terms and conditions for the return of containers to the manufacturer. A time limit of one year in which to return the container was imposed to minimize the company's investment requirements. This rule, although written on each customer's order acknowledgment form and invoice, is flexible in accordance with customers as they merit special consideration. The method used to determine the period the container is held by the customer is to assign a letter for each year and number serially thereafter. This letter and number are stamped on a metal tag and affixed to the container. They are recorded on all shipping documents and the invoice. When the container is returned by the customer, the letter and number prompt the accounting department to question any returns which have run beyond the period. (The serially numbered metal identification tag is removed and a new tag is issued when the container is reshipped.)

Still another requirement is that containers must be returned in good condition and are subject to reasonable repair charges. Inspection takes place at the receiving platform. Containers in doubtful condition are forwarded to the repair shed. A repair ticket is issued on any major repairs and the cost deducted from the customer's deposit. Minor repairs and painting are charged to manufacturing expense. Disputes concerning returnable containers are handled by the credit manager and sales department.

A tabulation by classes of containers shipped to customers is made monthly,

and the accounting entries to record this are as follows:

Dr. Returnable containers—Standard cost (hands of customers)
Cr. Returnable containers—Standard cost (in plant)
To transfer containers from the "in plant" account to "in hands of customers" account.

Dr. Accounts receivable — Customers
Cr. Reserve for returnable containers (deposit account)
To record the liability for customers deposits to be refunded upon return of container.

The accounts, reserve for returnable containers and returnable containers—standard cost (hands of customers) have subsidiary ledger sheets which give a breakdown of the amounts which were not returned in each of the preceding five years. Since the return policy is flexible, we do not record the profit on containers not returned until the end of the five-year period. Exhibit 1 is illustrative.

Note the zero balance for containers shipped in 1952. When returnable containers have been in the hands of customers for five years, it is presumed that they will not be returned and the values represented in the reserve account are transferred to income. At the same time the amount in the Returnable containers—standard cost (hands of customers) account is written off to the reserve for depreciation, since these items are now fully depreciated. The monthly accounting entry to record this would be as follows:

Dr. Reserve for returnable containers (deposit account)
Dr. Reserve for depreciation of returnable containers
Cr. Returnable containers—Standard cost (hands of customers)
Cr. Profit realized on returnable containers
To record profit on fully depreciated containers in hands of customers presumed not to be returned.

RESERVE FOR RETURNABLE CONTAINERS

SUBSIDIARY LEDGER ACCOUNT

Date		Folio	Total	1952 B	1953 C	1954 D	1955 E	1956 F	1957 G
1957									
Jan.	1	Balance	249,570	37,032	48,990	48,626	45,884	69,038	
	31	Sales 1-6	5,200						5,200
		Ret. Sales 1-7	(4,308)	(124)	(216)	(623)	(707)	(2,638)	
		Profit Realized 1-8	(2,500)	(2,500)					
Feb.	28	S 2-6	6,031						6,031
		RS 2-7	(7,678)	(145)	(471)	(843)	(1,150)	(4,784)	(285)
Dec.	31	S 12-6	3,799						3,799
		RS 12-7	(5,192)	(359)	(302)	(414)	(359)	(1,034)	(2,724)
		PR 12-8	(2,365)	(2,365)					
		Suppliers Returns 12-10	(168)						(168)
			253,228	0	43,593	39,666	35,917	38,218	95,834

EXHIBIT 1

The write-off of the cost variance attributable to the above items is discussed later in this article.

Depreciation of containers is based on a straight-line method on the combined values of standard cost plus the cost variance. The monthly accounting entry is as follows:

Dr. Depreciation of returnable containers

Cr. Reserve for depreciation of returnable containers

At times it is necessary to ship work-in-process inventory to the manufacturer's suppliers in returnable containers for additional manufacturing operations not handled in the home plant. The accounting for this transaction is as follows:

Dr. Returnable containers—Standard cost (hands of customers)

Dr. Accounts receivable — Misc.

Cr. Reserve for containers returnable

Cr. Returnable containers—Standard cost (in Plant)

This entry is reversed when the container is returned, thereby avoiding any cash transaction.

A physical inventory is taken annually, priced and extended at standard cost and compared with the returnable containers—standard cost (in plant) account. Any shortage or overage is adjusted through an inventory adjustment entry which is applied against the reserve for depreciation of returnable containers account. The purpose of handling the differences in this manner is to correct any omissions in scrapped containers reporting or any other quantity variance which occurred during the previous year.

SUPPORTING DATA - ANNUAL JOURNAL ENTRY TO TRANSFER RETURNABLE CONTAINERS

COST VARIANCE AMOUNT DUE TO DISPOSALS DURING 1957

Month	Containers Presumed not to be returned	Scrapped 3 yr. life	Containers 5 yr. life	Invty. Adjustment	Total
January	1,750	80	580		2,410
February	1,750	140	230		2,120
March	1,750	90	280		2,120
November	1,750	380	990		3,120
December	1,825	240	160	750	2,975
Total @ Std. Cost	21,075	1,450	4,420	750	27,695
*Apply Cost Variance	24,931	1,715	5,229	887	32,762
Total Value of Disposals	46,006	3,165	9,649	1,637	60,457

Returnable Containers - Standard Cost (In Plant) acct. balance 1/1/57	24,900
Returnable Containers - Standard Cost (Customers Hands) acct. balance 1/1/57	93,025
Total Standard Cost of Containers	117,925
Returnable Containers - Cost Variance, acct. balance 1/1/57	139,050

*Calculation = 139050 ÷ 117,925 = 118.296%

EXHIBIT 2

Disposal of Returnable Containers

It is the responsibility of the repair shop foreman to declare a container as being beyond repair and to issue a monthly scrap report by class, thus enabling the accounting department to remove these containers from the fixed asset records. Scrapped containers are considered to be fully depreciated and are written off at standard cost. At the end of the year, the per cent that the variance account bears to the standard cost is applied to the total amount of containers disposed of during the year. This, as illustrated in Exhibit 2, enables the accounting department to facilitate monthly closings and gets rid of the necessity of keeping cumbersome detailed schedules to apply the cost variance more particularly.

The monthly accounting entry is:

Dr. Reserve for depreciation of returnable containers
Cr. Returnable containers — Standard cost (in plant)

The annual accounting entry is:

Dr. Reserve for depreciation of returnable containers
Cr. Returnable containers — Cost variance

Export sales using returnable containers are considered as a sale of the container. This is not a common transaction but would be handled through the following entry:

Dr. Accounts receivable—Customers
Cr. Returnable containers—Standard cost (in plant)
Cr. Returnable containers—Cost variance
Cr. Gain or loss on sale of returnable containers.

Balance Sheet Liability for Deposits on Containers

In order to estimate what amount in the reserve for returnable containers will be paid out in the current year and so should be classified as a current liability and what amount will be paid in subsequent years and is classifiable as a deferred liability, it is necessary to arrive at some percentage basis for this prorating. A suggested method is to take the beginning balances in the reserve for containers returnable subsidiary ledger for each of three preceding years and relate to each the containers returned in the year following. An average of these three percentages is used as the prorating percentage for the current year.

A Solution to a Common Problem

The returnable containers represent a growing problem in many companies. More money is involved than may be realized. Certainly efficiency of operation is involved. I have described in this article a procedure which has been helpful in a company in which the containers are wire and cable reels. We feel the procedures are adaptable to companies shipping in other types of containers.

"Shadow Prices" For Evaluating Alternative Uses of Available Capacity

by C. F. DAY

CONSIDERABLE EMPHASIS is currently being given in business literature to the measurement of the rate of return on proposed investment. Several alternative methods, such as pay-off period and discounted cash flow, are advanced. Proponents of each method stress the advantages of their proposal and cite the limitations of the others. This is good, for through the expression, discussion, and criticism of ideas, new and better measuring methods are sure to result. There is the danger, however, that this concentration on methodology may cause us to lose sight of the purpose behind the method—which is increasing the profitability of the enterprise.

It is fatal to go blindly ahead. Although proper plant and equipment are certainly most important to profitable operations, the fact remains that the purchase of a particular piece of equipment, even if economically justifiable, may not represent the best possible use of money. There is always the possibility that the purchase of another type of equipment or better utilization of present equipment will be superior in attaining the goals of the enterprise. Thus, a problem exists even if the money for a capital expenditure is available and application of the several methods of calculating return agree. How can the accountant evaluate some of the alternative uses of the money? Can he tell which process or machine is actually most valuable to the enterprise? Can the present capacity be more fully utilized?

The advantages of proper machine utilization are obvious and need not be outlined here. There is a technique for finding an optimum loading schedule which will produce as a by-product important information the accountant will find useful in evaluating investment proposals. The evaluators, often called shadow prices or implicit prices, indicate the contribution of each process to total profit. A shadow price can also be used to choose the proper product mix of several alternatives and to decide whether or not a new product should be produced. This programming technique or activity analysis is thus a powerful analytical tool which will support and amplify the information produced by

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usual accounting means. Fortunately, the basic concepts are relatively simple and easily demonstrated. The purpose of this paper is to illustrate, by means of a case example, the practical application of programming machine utilization and the useful information obtained as a by-product.

The Case and the Problem

The Widgit Manufacture Company was one of the principal producers of high quality widgits in the country. The launching of Sputnik I and the subsequent acceleration of our own rocket program increased the demand for widgits to such an extent that the company was hard pressed to fill orders. Production of the new counter-sunk widgit had to be postponed until current production schedules were straightened out.

In reviewing the situation, the sales manager reported that demand for both standard widgits (with a right hand thread) and radical widgits (with a left hand thread) was very strong. He felt that the company had three alternatives:

1. Concentrate on standards.
2. Concentrate on radicals.
3. Manufacture both standards and radicals.

The equipment at the plant was divided between machines for standards, machines for radicals, and general purpose machines that could handle both. Investigation revealed that there were four critical operating areas: threading, heat treating, standard machining and radical machining. Capacities of other machine centers were adequate to meet any expected demand. However, in the four bottleneck areas, capacities were limited. This is where proper machine ultilization would pay the biggest dividends. A survey revealed the following capacity for these operations.

	Producing standards alone	*Producing radicals alone*
Heat treating	12,000 Units	11,000 Units
Threading	10,000 "	15,000 "
Standard machining	9,000 "	— "
Radical machining	— "	10,000 "

These capacities are given in terms of producing either standards or radicals, but not both. If both are made, for each standard produced the capacity to produce radicals is reduced. For heat treating, this rate of substitution is 11,000/12,000 or 11/12 of a radical given up for each standard produced. Similarly in the threading operation, for each standard produced the capacity to thread radicals is reduced 15,000/10,000 or 1.5 units.

A Solution Recognizing Capacity Restraints

When some value is placed on standards and radicals, it will be possible to make a choice of production policy. Fixed overheads are assumed to be independent of product mix in the short run. Thus the value of standards and radicals should be in terms of contribution to profit and fixed overhead, that is, sales price less variable production costs. In this problem, standards have a "contribution" of $15 per unit, and radicals $12 per unit. Looking at the capacity restraints and contribution figures, it would appear that the best results might be obtained by producing as many standards as possible (at a contribution of $15) and processing as many radicals as the remaining capacity allowed (at a contribution of $12). Maximum machining capacity limited the number of standards that could be heat treated, threaded, and machined to 9,000. For each standard processed, the capacity to thread radicals is reduced 1½ units. Thus, it would be possible to thread 1,500 radicals, as follows:

Total Capacity (Radicals)	*Capacity Used For Standards* (1 Standard = 1.5 Radicals)	*Capacity Left For Radicals*
15,000		15,000
	(1.5) (9,000)	— 13,500
		1,500

For each standard processed, the capacity to heat treat radicals is reduced by 11/12's of a unit. Thus, 2,750 units of radicals could be heat treated, as shown below:

Total Capacity (Radicals)	*Capacity Used For Standards* (1 Standard = 11/12 Radicals)	*Capacity Left For Radicals*
11,000		11,000
	11/12 (9,000)	— 8,250
		2,750

The monthly production would then be 9,000 standards and 1,500 radicals. Note that some heat treating and radical machining capacity would not be required. The contribution to profit and overhead for this product mix would be:

9,000 X $15 =	$135,000
1,500 X $12 =	18,000
	$153,000

Graphic Methods: The "Feasibility Region," "Equal-Profit" Lines

This is, in fact, a very good choice but not the one which will produce the maximum contribution. Possibly the easiest way to solve this problem is by

using graphic methods. Exhibit 1 shows the limitations imposed by the maximum capacities of the four bottleneck operations. It is not really necessary to find the equations of these lines to plot them, but the equations are useful and not difficult to obtain. The machining capacities are extremely easy. It is possible to machine not more than 9,000 standards and not more than 10,000 radicals. Heat treating one radical uses up 12/11's units of the capacity available to heat treat standards. Threading one radical uses 2/3's of a unit of the capacity available to thread standards. Thus the equations are:

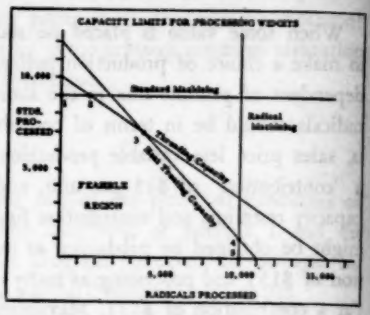

EXHIBIT 1

Operation	*Equation*	*Operation*	*Equation*
Standard	S = 9,000	Heat treating	S + 12/11 R = 12,000
Radical	R = 10,000	Threading	S + 2/3 R = 10,000

Since the object is to maximize the profit contribution, there is really no sense in considering an operation that is run at less than its highest possible level. The lines on Exhibit 1 represent the maximum poundages that can be processed. Thus, it would be impossible to process 9,000 standards and 2,000 radicals because, if 9,000 standards are threaded, only 1,500 radicals can be threaded. In fact, it is only possible to process a combination of the two found in the "feasible region," that is, to the left of and below the determining restriction. This six-sided feasible range has been reproduced in Exhibit 2 and the intersections of the capacity limits numbered. Note that the guess at the optimum point made earlier, that of producing 9,000 standards and 1,500 radicals is Point 2 on Exhibit 2, the intersection of the standard machining capacity restraint and the threading capacity restraint. Operating at this level leaves some heat treating capacity and radical machining capacity unused.

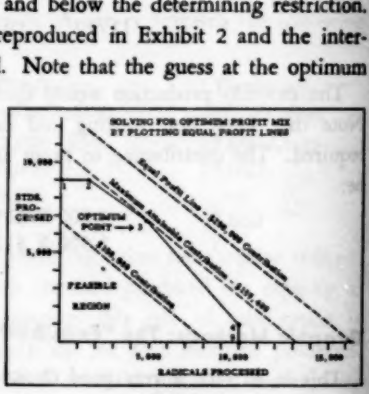

EXHIBIT 2

Although the plant could be operated at any point inside the figure, it is rather obvious that none of those

points could be a maximizing point. It would always be more profitable to move outward as far as possible, that is, to the boundary line. The optimum point can be found by plotting equal profit lines, that is, lines that contain all the possible mixes of standards and radicals that will give the same profit. The point on the boundary that touches the highest equal profit line will indicate the product mix that maximizes profit contribution.

The profit contribution for any mix can be calculated by multiplying the radicals produced by $12 and the standards produced by $15 and adding the results or, symbolically:

$$\$12R + \$15S = \$ \text{ Contribution}$$

On Exhibit 2, three of these equal-profit lines were plotted for contributions of $100,000, $200,000 and the maximum of $159,400. The maximum attainable equal profit line intersects the boundary line at point 3 which is a mix of 4,714 radicals and 6,857 standards.

A Method for Determining Optimum Profit Contribution

It is clear, then, that finding the product mix that produces the largest contribution is a three-step process. The first step is to find what product mixes are possible. This is done by plotting the restraint lines and determining the feasible region. The next step is to determine the relative value of standards and radicals. This is done by plotting equal profit lines. The series of parallel lines indicate the combinations of product mixes that will give various contributions. The final step is to choose the product mix that is within capacity limitations and produces the maximum total contribution. The product mix will occur where the largest equal profit line intersects the boundary.

The relative value of radicals and standards is important. This is just the ratio of radical contribution to standard contribution and means that one radical produces the same contribution as 12/15 or 4/5 of a standard. It is interesting that this ratio has a geometric interpretation. Actually it is the slope of the line and determines how the line will be slanted on the graph. If the ratio gets larger, the equal-profit line is steeper. If the ratio should get smaller, the equal-profit line is more nearly horizontal.

This property helps to evaluate the effect of cost or price changes on the optimum product mix. It is the relative change that is important. If the contributions for radicals and standards were both exactly doubled, for instance, the maximum attainable equal-profit line in Exhibit 2 would look exactly

the same. The total contribution would change, in fact, be doubled. This is true because the ratio of the contributions would not have changed, for $24/30 = 12/15 = 4/5$. The optimum point is the same and only the dollar amount of contribution would be different. Thus, any combination of contributions having a ratio of 4/5 would produce the same optimum point, with only the dollar contribution varying.

This thinking can be carried one step further. The shape of the boundary line will not be changed by cost or price fluctuations because the restraint lines are determined from the physical capacities to process widgits. Since it is the ratio of the contributions that determines where the equal profit lines will intersect the boundary line, it is possible to find where the optimum point will be by examining the ratio. This may be illustrated as follows:

If the ratio of radical to standard contributions is:	*The optimum point will be:*
More than 12/11	Point 4
equal to 12/11	Segment 34
between 12/11 and 2/3	Point 3
equal to 2/3	Segment 23
less than 2/3	Point 2

The critical ratios (12/11 and 2/3) are the slopes of the restraint equations for heat treating and threading. When the contribution ratio is equal to one of these figures, the equal profit line will correspond with the restraint line and any product mix on the line will produce the same contribution. In this example, the contribution ratio was 4/5, which falls between 12/11 and 2/3. When the ratio increases to more than 12/11, i. e. radical contribution larger than standard, it becomes profitable to produce more radicals and the optimum point shifts from point 3 to 4.

Changes in Capacity Restraints

So far, the company has determined what its best production schedule should be to maximize its return. Since demands for all types of widgits are strong, the company can earn more profit if it can increase production. But what kind of capacity should be expanded first—machining capacity, heat treating, or threading? Even though there may be economic reasons for expanding all capacities, there is one which, if expanded, will earn more return than any other. For simplicity, let us limit ourselves to a consideration of threading and

heat treating capacity. Increasing machining capacity at this stage will earn no return because both standard and radical machining capacity is not being fully utilized to produce the optimum mix.

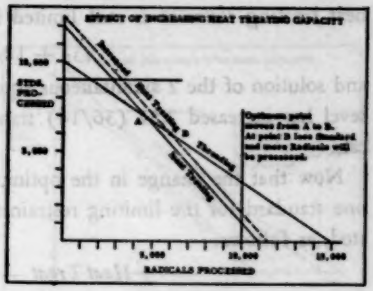

EXHIBIT 3

Reference to Exhibit 3 will show that increasing heat treating capacity will shift the boundary line outward to the right. The new intersection with the threading restraint, therefore, will be below the present one at a point where more radicals but less standards will be produced. If heat treating capacity is increased just enough to treat one more standard, it would be possible to treat 11/12 of a radical. The change in the optimum point can be found by using the equations for the capacity restraints. If Δ represents the change in products produced, then:

$$\Delta_S + 12/11\ \Delta_R = 1 \text{ (change per unit new capacity)}$$

is the equation for the change in capacity for—

1) $S + \Delta_S + 12/11\ R + 12/11\ \Delta_R = 12{,}001$ (new capacity equation)
2) $S + 12/11\ R = 12{,}000$ (old capacity equation)

Subtracting 2 from 1 gives

$$\Delta_S + 12/11\ \Delta_R = 1$$

Since threading capacity has not changed, the maximum amount of widgits threaded per month cannot exceed the equivalent of 10,000 standards, so that:

$$\Delta_S + 2/3\ \Delta_R = 0$$

The solution of these simultaneous equations shows that the optimum operational level will be increased by 2.36 (33/14) radicals and decreased by 1.57 (22/14) standards.

Similar reasoning will show the effect of increasing threading capacity an amount necessary to thread one more standard. In this event, the threading capacity limit also moves upward to the right, parallel to itself, and intersects the heat treat restraint at a point where standards will increase and radicals decrease (Exhibit 4). The equations are:

$$S + \Delta_S + 2/3\ R + 2/3\ \Delta_R = 10{,}001 \text{ (new capacity equation)}$$
$$S + 2/3\ R = 10{,}000 \text{ (old capacity equation)}$$
$$\Delta_S + 2/3\ \Delta_R = 1$$

Again, since heat treating capacity has not changed, the new position on the heat treating restraint is still limited by the restraint equation, so that—

$$\triangle_s + 12/11\ \triangle_R = 0$$

and solution of the 2 simultaneous equations shows that the optimum operations level has increased 2.57 (36/14) standards and decreased 2.36 (33/14) radicals.

Now that the change in the optimum point has been found for changes of one standard for the limiting restraints, the effect on contribution can be evaluated, as follows:

	Heat Treat			*Threading*			*Machining*	
	Units	*Contribution*	*$*	*Units*	*Contribution*	*$*	*Std.*	*Rad.*
Change in:								
Standards ..	—22/14	$15	—23.57	36/14	$15	38.57	0	0
Radicals ...	+33/14	12	28.28	—33/14	12	—28.28	0	0
Change in contribution for increase of 1 unit			$ 4.71			$10.29	0	0

Thus, increasing the heat treating capacity the equivalent of one standard widgit will return $4.71 while increasing the threading capacity one unit will return $10.29. If both capacities are increased so that one more standard can be processed, then $15 should be returned and $10.29 + $4.71 does equal $15. It is interesting to note that, if capacities are increased in this manner, then the optimum point will change by one standard and radicals will remain the same (Exhibit 5).

The same sort of analysis, carried out in terms of increasing capacities one radical, would lead to slightly different results. Since heat treating one radical is equivalent to 12/11's standards, the return for increasing heat treating capacity 1 radical would be $4.71 × 12/11 or $5.14. For threading, one radical is equivalent to 2/3 of a standard, so the return would be $10.29 × 2/3 or $6.86. Solving a set of simultaneous equations similar to those for standards, would result in this tabulation.

	Heat Treat			*Threading*			*Machining*	
	Units	*Contribution*	*$*	*Units*	*Contribution*	*$*	*Std.*	*Rad.*
Change in:								
Standards ..	—12/7	$15	—25.72	+12/7	$15	25.72	0	0
Radicals ...	+18/7	12	30.86	—11/7	12	—18.86	0	0
Change in contribution for increase of one radical			$ 5.14			$ 6.86		

Shadow Prices — and Illustration of Usefulness

The "changes in contribution" resulting from the one unit change in capacity restraints are the shadow or implicit prices mentioned previously. Increasing machining capacity will return nothing, since there is already excess capacity in this area when all facilities are used to achieve a maximum return. This fact was certainly not obvious from an examination of the capacity limitations alone. The shadow prices show that an increase of threading capacity will show the greatest return possible.

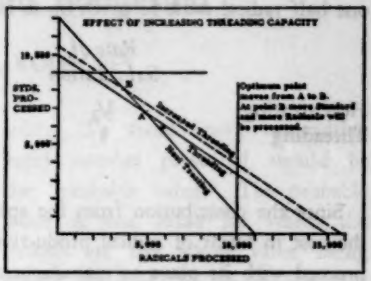
EFFECT OF INCREASING THREADING CAPACITY
STDS. PRO-CESSED
Optimum point moves from A to B. At point B more Standard and more Radicals will be processed.
Increase Threading Capacity
Most Threading
RADICALS PROCESSED

EXHIBIT 4

These evaluators serve the accountant in another important way. Given a choice of several alternatives, say, the investment in improved equipment for all production facilities, it is not always easy to tell which machine to purchase. Each may be justifiable from a return-on-investment standpoint. However, it may not be apparent which production area actually is most important to the company. The shadow prices do give such an indication.

Suppose the company is considering producing a special countersunk widgit for which the profit contribution is estimated to be $10.50. The engineers have estimated that it would take one half as long to heat treat the special as it would a radical but that it would require the same capacity to thread a special as a radical. Both capacities are limited and some regular production will have to be given up if the special is to be processed. The question is whether it would be profitable to give up some regular production order to produce the special. The answer is not readily apparent. The contribution for the special is lower than that for either of the other widgits. On the other hand, the amount of time required on bottleneck operations to process one special is less than that required for the regular products.

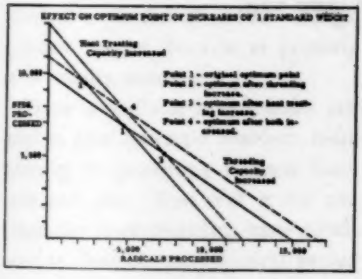
EFFECT ON OPTIMUM POINT OF INCREASES OF 1 STANDARD WIDGIT
Heat Treating Capacity Increased
Point 1 - original optimum point
Point 2 - optimum after threading increases.
Point 3 - optimum after heat treating increases.
Point 4 - optimum after both increased.
STDS. PRO-CESSED
Threading Capacity Increased
RADICALS PROCESSED

EXHIBIT 5

The value of changing capacities by one radical has just been calculated and it is known that one radical must be given up to thread one special and that one half radical must be given up to heat treat one special.

	Rate of Substitution	*Value of changing capacity one unit*	*Value of radical capacity given up*
Heat treating	½	$5.14	$2.57
Threading	1	6.86	6.86
			$9.43

Since the contribution from the special shape is expected to be $10.50 and the cost in terms of radical production lost is only $9.43, the company could proceed with its plans to manufacture the special widgit.

Elementary Linear Programming

The case example just presented is a simple illustration of linear programming. This two-product problem could be solved with graphic and simple algebraic methods. In general, this will not be possible. Most real problems involve a choice between several alternatives, rather than two or three. Since we are blessed with only three dimensional perception, the graphic methods used above are limited. However, programming techniques based on the same ideas have been developed so that relatively complex problems of this nature can be solved.

While the proper product mix in and of itself is of tremendous importance, the accountant may find the information supplied by the shadow prices of even greater importance. These prices are used in the programming process to make sure that an optimum solution is obtained. The solution usually applies to an area of business other than accounting yet the byproduct, the shadow prices, can be useful to the accountant in many ways.

Probability Approach to Planning and Budgeting

by MARVIN J. KOLHOFF*

NOTABLE AMONG THE FALLACIES current in business is the assumed precision of single-valued numbers once they are selected and printed. A numerical forecast for a dozen different items, listed on a single page and totaled at the bottom, conveys the impression that all of the numbers are valid with a reasonably equal degree of certainty. This is probably very far from the truth. Some of the numbers are overly optimistic and some are overly pessimistic. Some have been arrived at studiously with a great deal of sound research as a basis, while others have been determined hastily and arbitrarily. In addition, independent of the degree of optimism and care, some of the numbers present fairly firm predictions while others contain a very large element of chance. Except in representing the count of a number of discrete things, numbers do not describe as precisely as is usually assumed.

There is available a tool which can help to give uncertain numbers more meaning in presenting business forecasts and data. This tool is the one which the mathematicians have developed to describe mathematical probability. To avoid being misleading, every number presented should be the "probable value." The probable value is that value for which the chances of the actual value being higher are equal to the chances that the actual value will be lower. For the statistically minded, the probable value corresponds to the mean of the probability distribution curve. Supplementing this single value, each number should have another term associated with it which describes its "firmness," or the range of the likely deviation of the actual value from the probable value. A more rigorous mathematical analysis of the nature of the probability distribution could tell whether or not it is likely to be "skewed" toward the high or low side of the probable value, but a good approximation, applying in the vast majority of instances, is that the deviations from the probable value will be evenly distributed above and below. The firmness of a number may, for example, be expressed in terms of the maximum plus or minus deviation of the actual value from the probable value expected to hold 80 per cent of the time.

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In an example below, this approach is applied to the sales forecast for an assumed business with five product lines. The tabulation, which compares an assumed sales budget in the more conventional form with an assumed true picture expressed in terms of a probability budget, follows:

Product lines	*Conventional sales budget (amts in millions)*	*Probability budget*	
		Probable sales (amts in millions)	*80% Confidence limits ± %*
A	$ 25	$ 40	50
B	13	10	30
C	18	18	5
D	48	60	20
E	28	30	10
Total sales	$132	$158	15*

Product Line A is one which contains some very large potential sales on which there is a large degree of uncertainty. Being a conservative man, the manager responsible for this line chose to express this degree of uncertainty in his conventional form of sales budget by discounting his estimated sales below the probable level but not quite down to the minimum of the 80 per cent confidence limit ($20,000,000). Hence the conventional sales budget shows $25,000,000 for Product Line A instead of the more true $40,000,000, plus or minus 50 per cent. The aggressiveness and emotional state of mind of the manager of Product Line B differs in that he tends to stretch his conventional form of sales forecast to the limit on the high side. He shows a $13,000,000 sales budget instead of the more true $10,000,000 plus or minus 30 per cent. Further variations in personality, circumstances and chance can produce figures like those for the other lines shown.

The total of the conventional sales budget is $132,000,000 which, also conventionally, is understood to be a good figure within about 10 per cent. Actually, the more probable sales volume is nearly 20 per cent higher than this or $158,000,000. Also, note that the probable maximum deviation from this more probable value is plus or minus 15 per cent.

The analysis of business indicators, market position trends and sales district reports is always made with some intuitive mental juggling to arrive at an interpretation of a situation or a plan. At this time, we are far from being able to estimate probable values and confidence limits with the precision that would satisfy a mathematician. Nevertheless, the valuable intuitive opinions available in experienced people should be shared and factored into plans. The language of probability can be used for this purpose.

* Combined probability; not a sum.

Material Control in an Electronic Production Control System

by L. P. GUIDI and P. J. GUTIERREZ

HOW CAN WE GET THE RIGHT MATERIALS to the right place on the production line at the right time? How can we eliminate material shortages caused by no material or the wrong material? How can cost accounting get the proper paperwork and proper costs to control inventories? Good questions? Yes. And when we are dealing with thousands of small and often expensive parts, such as those used in the electronics industry (further complicated by the inevitable flow of engineering changes), we have a tough problem on our hands.

The happy solution of this problem is to incorporate the materials scheduling and requisitioning functions into a well-oiled, integrated production control system that carries the ball from drawing board to production line to accounting records. Today's electronic computers and the skills of analysis and programmers can make such an integrated system a reality. Integration cannot be a one-man job. It is, rather, the combined effort of engineer, production manager, purchasing agent, cost accountant, etc. But these people have to devote their time to handling the problems that arise in the separate areas. Integration is not something which can be done overnight. It is a job which requires delicate coordination and good salesmanship. In the meantime, problems must be solved and there is much to be gained in taking care of a few loose ends right now while preparing for the future.

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PEDRO J. GUTIERREZ, Peninsula-San Jose Chapter (San Francisco, 1953), is manager of Data Processing at Lenkurt Electric Co., Inc., San Carlos, California. He joined Lenkurt six years ago to supervise the Machine Accounting Section then in its infancy. Mr. Gutierrez was formerly with General Mills, Inc., as Tab Supervisor, and before that he was Statistical Department Manager for the Esso Standard Oil Co. in Puerto Rico. He is a charter member of the Peninsula-San Jose Chapter.

The "Building Block" Approach to Integrated Data Processing

What are we doing about integration? We are going at it slowly but surely. The data processing department used to handle material lists, standard cost revisions, standard cost file upkeep, standard material requisition distribution and standard material requisition costing as separate functions. Now, as you will see, these functions are pretty well inter-related. In short, our company has adopted the building block approach, setting up the system function by function while acquiring the processing tools piece by piece. We started in 1952 with a few items of conventional tabulating equipment including an IBM 602A multiplier. In 1953 we graduated into the 604 (electronic calculating punch) and 407s (accounting machines); in September of last year, we brought in the basic IBM 650 computer.

We brought in the 650 computer because our monthly bill for conventional tabulating equipment and personnel was substantial and we figured that, by converting our regular tabulating functions to the computer, we could break even. How? By releasing some auxiliary equipment and taking on new functions without additional personnel. Our plan paid off. We not only broke even—we are saving money. We are not concerned whether we are using the equipment to its fullest electronic brain capacity. We simply ask ourselves, "are we saving money?" If the answer is, "yes," we go ahead. And while we are earning our way, we are developing talent and experience. Better still, we have a chance to "debug" the various programs so that eventual integration will be painless.

Applying Electronic Equipment to Material Requisitioning

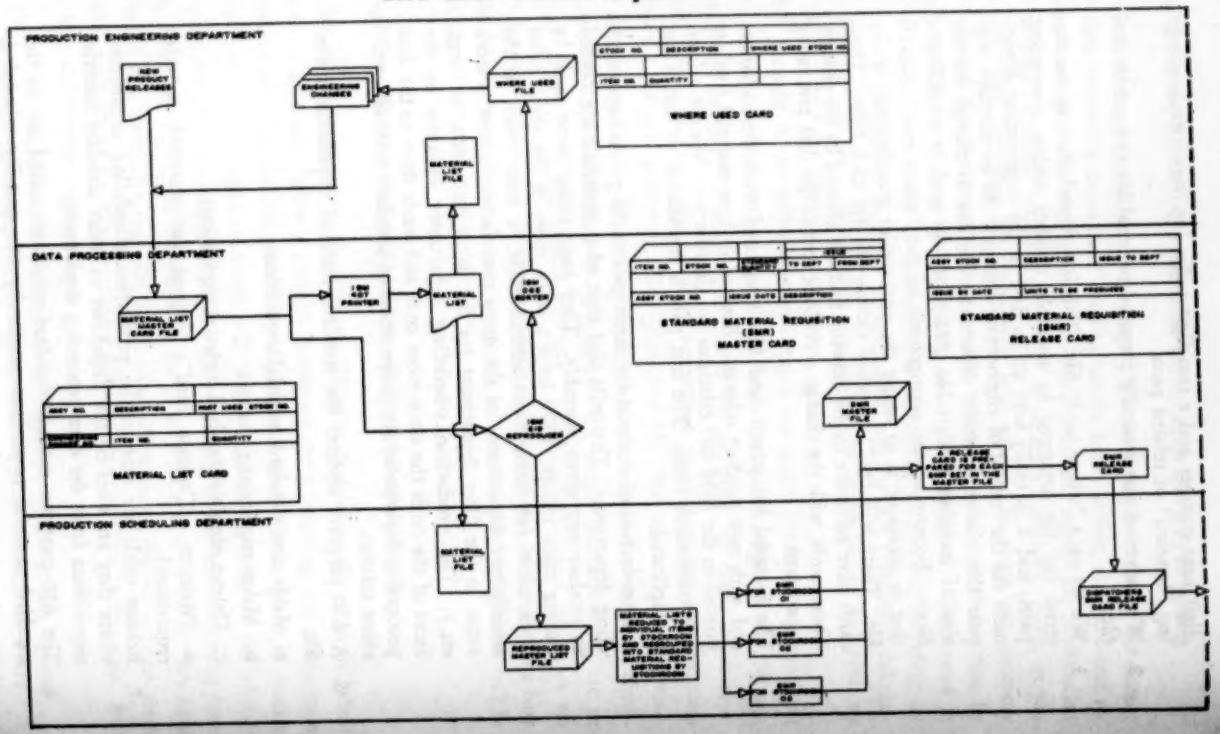
Exhibit on pages 82-83, Flow Chart—Material Requisition Function will illustrate our approach. When a product is released for processing, one of the main activities of a production scheduling department is to set the gears in motion to assure that the right materials will be in the staging areas of the various production lines precisely on time for the beginning of the manufacturing process. We must be sure of the material, the paperwork and the control. We have selected this particular function as an example of our progress in data processing, because we are already using a little bit of integration in this area. Step by step, this is what we have done.

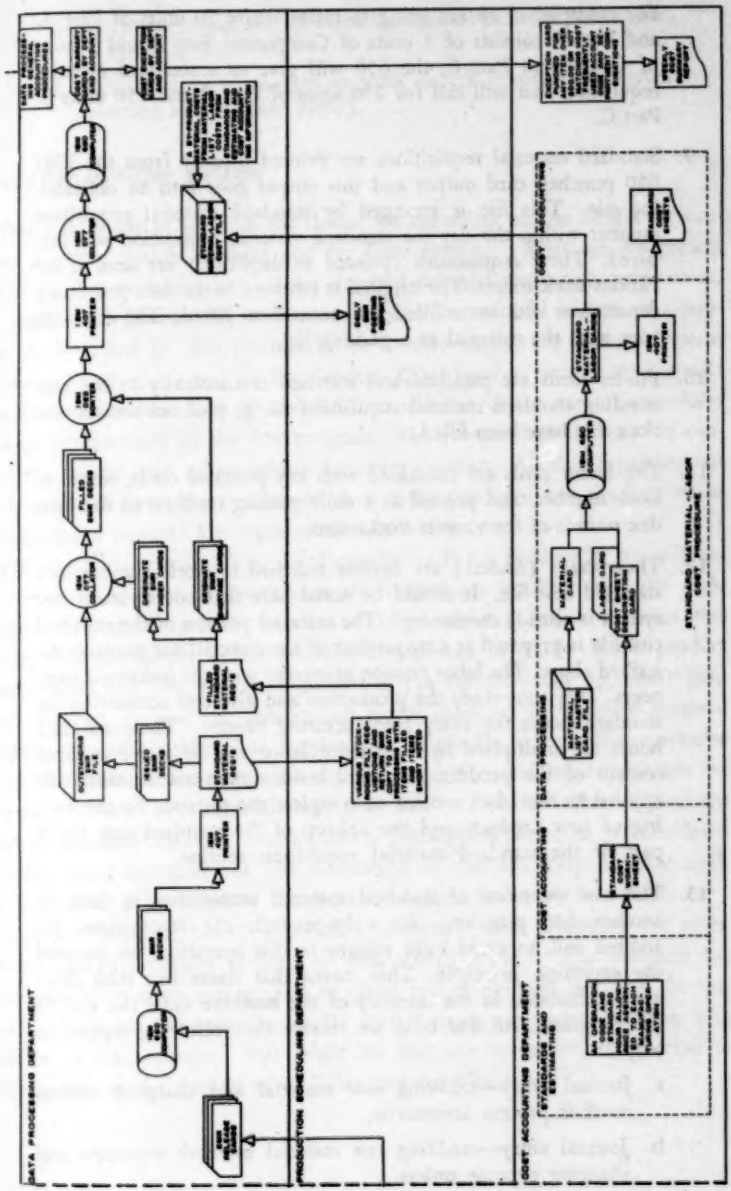
1. We established a numerical ten-digit parts numbering system broken down into a three-digit prefix for class of material, a five-

digit base number and a two-digit suffix for conveniently grouping "families" of related parts.

2. We converted our manually prepared material list to a punch card file.
3. We set up a "where used" file. This is a reproduction of the material list file arranged in assembly number within component parts, and it is easily kept up to date in the engineering department for the control of engineering changes. As an example, suppose that the engineering department decides to change the design of transformer Part No. 012-34567-89 used in 25 different filters. Because of the arrangement of the "where used" file, all that is necessary is to locate the part under transformers in the file. There will be 25 punched cards—one for each filter. These cards have reference to the drawing number affected by the change. These cards, with the change noted, are sent to the data processing department.
4. The material list punch card file is updated with these changes and with new product releases. Revised or new material lists are printed in the IBM 407 tabulator for distribution. We use a four-part continuous form. The first part is translucent so that it can be duplicated.
5. A reproduction of material list cards goes to the production scheduling department. This tells that unit what materials are needed to produce any given assembly. They hand-group these cards by issuing stock rooms. (We have a stock room in the sheet metal department for items manufactured there, a stock room in the transformer department for the items manufactured there, a stock room in the filter department for the items manufactured there, etc.). The production scheduling department indicates on the faces of the cards the stock room code and sends them to the data processing department for preparation of standard material requisition masters.
6. A 650 program updates the standard material requisition master file.
   a. Adds new standard material requisitions
   b. Makes engineering changes
   c. Deletes obsolete standard material requisitions
   d. Produces a "release card" (request for standard material requisition).
7. Release cards are sent to the production scheduling department where they are used by the dispatcher to order standard material requisitions from the data processing department.
8. The 650 program extends standard quantities called for in the standard material requisition master by the quantity scheduled.

Flow Chart—Material Requisition Function


PRODUCTION ENGINEERING DEPARTMENT
NEW PRODUCT RELEASES
ENGINEERING CHANGES
WHERE USED FILE
WHERE USED CARD
MATERIAL LIST FILE
DATA PROCESSING DEPARTMENT
MATERIAL LIST MASTER CARD FILE
1240 KEY PUNCHER
MATERIAL LIST
1244 CARD REPRODUCER
STANDARD MATERIAL REQUISITION (SMR) MASTER CARD
STANDARD MATERIAL REQUISITION (SMR) RELEASE CARD
MATERIAL LIST CARD
1244 CARD REPRODUCER
SMR MASTER FILE
A RELEASE CARD IS PRE-PARED FOR EACH SMR SET IN THE MASTER FILE
SMR RELEASE CARD
PRODUCTION SCHEDULING DEPARTMENT
MATERIAL LIST FILE
REPRODUCED MASTER LIST FILE
MATERIAL LISTS REDUCED TO INDIVIDUAL ITEMS BY STOCKROOM AND REPRODUCED INTO STANDARD MATERIAL REQUISITIONS BY STOCKROOM
SMR STOCKROOM 01
SMR STOCKROOM 02
SMR STOCKROOM 03
SUMMARIZED SMR RELEASE CARD FILE


DATA PROCESSING DEPARTMENT
PRODUCTION SCHEDULING DEPARTMENT
COST ACCOUNTING DEPARTMENT
STANDARDS AND ESTIMATING
COST ACCOUNTING
DATA PROCESSING
COST
ACCOUNTING
STANDARD MATERIAL-LABOR COST PROCEDURE
MATERIAL CARD
LABOR CARD
COST SHEET DESCRIPTION CARD
STANDARD MATERIAL-LABOR CARDS
IBM 650 COMPUTER
IBM 407 PRINTER
IBM 514 REPRODUCER
IBM 407 PRINTER
IBM 514 REPRODUCER
IBM 407 PRINTER
IBM 514 REPRODUC

For example, if we are going to manufacture 50 units of Part A, and Part A consists of 5 units of Component Part B and 3 units of Component Part C, the 650 will give us a standard material requisition that will call for 250 units of Part B and 150 units of Part C.

9. Standard material requisitions are printed directly from the IBM 650 punched card output and this output goes into an outstanding file. This file is arranged by standard material requisition number within the day the standard material requisition was prepared. These requisitions (printed in duplicate) are sent to the various stock rooms. The original is returned to the data processing department with items filled and items short noted. The duplicate goes with the material as a packing list.

10. Finder cards are punched and matched mechanically to the outstanding standard material requisition file to pull out the requisitions that have been filled.

11. The finder cards are combined with key punched cards, sorted to stock number, and printed as a daily posting medium to the Kardex records of the various stockrooms.

12. These cards (finders) are further matched to stock number to a standard cost file. It should be noted here that our standard cost system is already mechanized. The material portion of the standard cost file is prepared as a by-product of the material list program described above. The labor portion originates with the industrial engineers. They time-study the production and give cost accounting the standard hours for every manufacturing process. These standard hours are multiplied by a standard labor rate to arrive at labor content of the product. Standard burden rates are automatically applied to the labor content to complete the picture. So the costing of new products and the upkeep of the standard cost file is part of the standard material requisition routine.

13. The cost extension of standard material requisitions is done on another 650 program. As a by-product, the transactions are audited and, to avoid huge volume in this operation, we adopted the exception principle. This means that items less than $200 are accumulated in the memory of the machine until the end of the program. At that time we receive the following reports as output:

    a. Journal entry—crediting raw material and charging various work-in-process inventories.

    b. Journal entry—crediting raw material or work-in-process and charging expense orders.

c. Exception listing for all items transferred between inventories, in excess of $200.

d. Detail listing of charges to work orders (expense, new construction and military items).

Ready for Greater Volume

This illustration of some of the things we are doing on the IBM 650 computer is pretty straight-forward and far from exciting. What are we getting out of it? Let us take a look at the standard material requisition preparation. To manufacture Product X, we have to request the material content of assemblies A, B, C and D. For Product Y, we have to request the material content of assemblies B, C, D and E. For Product Z, we have to request the material content of assemblies A, B, D and E. This selection of the various assemblies is done automatically by the 650 program. The pre-punched release card contains the combination of assemblies for every product. All the dispatcher has to do is to jot down the number of units to be produced and the date when the material is wanted. The machine takes care of the rest.

The result is control. When the dispatcher calls for Product X, we will get all the standard material requisitions the stockrooms need to issue the *right* material to put the product together. To get the full impact of what this means, simply multiply a few hundred requisitions by a few dozen product combinations and you will get a picture of the volume—now accurately handled. Further, because the outstanding file is arranged by standard material requisition number *within date,* regular audit of the file will reveal any overdue requisition. This makes it possible for us to question unfilled requisitions before they blossom into material shortages. The control thus achieved over the flow of standard material requisitions is highlighted when it is considered that the paper necessary for cost accounting to cost and keep accurate track of inventories is provided by the process. Again, the result is control.

And our "building block" approach to integrated data processing has given us the capacity necessary to keep up with added volume. The company has been expanding at an average rate of about twenty per cent per year. In this area, at least, we are ready to handle several times our present volume with little or no cost increase. You might say that our management has tried to keep its feet on the ground while "Shooting for Cloud 9."

Did We Realize on that Capital Outlay?

by ARTHUR V. K. DEEKENS*

OFTEN A COMPANY will appropriate funds for the purpose of buying a piece of equipment or constructing a building without ever giving a thought to making a report afterwards to determine whether or not the return on investment or savings realized was in line with the original forecast. Some form of report on accomplishment should be prepared on all projects which are undertaken on a savings or return-on-investment basis. This report could be prepared after the close of the first full year's operation or existence of the completed construction, or after a longer interval of time if the operation for the first full year has been irregular. Exhibit 1 constitutes a sample accomplishment report which can be used as a guide for nearly any type of project.

The report is accompanied by footnotes. The following are possible examples on the data given:

> The adjustment column shows the original forecast as it would have been had material prices, labor rates, depreciation rates and all other expense rates been forecast at the level prevailing during the first year's operation with the new equipment or facilities. It represents the forecast adjusted for:

Higher material delivered cost	$200
Increased labor rates	(100)
Increased maintenance labor rates	(50)
Effect on total savings-increase (decrease)	$50

As indicated in the "actual" column, total savings during the first year's operation were more than forecast in original project, adjusted for changes in economic conditions, because of:

Used less material than forecast ...	$700
Labor rate increase and use of one more man part time	(300)
Maintenance costs lower than forecast	450
Increased depreciation due to higher cost of equipment	(180)
Effect on total savings-increase (decrease)	$670

In the foregoing it has been assumed that the information listed in the forecast column was shown in the original appropriation request. The

* Chief Accountant, Old Hickory Chemical Co., Richmond, Virginia.

ACCOMPLISHMENT REPORT

Project No.: A 46
Date Authorized: 1-10-57
Location: X Plant
Date Operation Started: 4-1-57

	Appropriation Request		
	Forecast	Forecast Adjusted For Changes In Economic Conditions	Actual First Year's Operations Ending March 31, 1958
GENERAL DATA			
Annual Production	5,000,000 lbs.	5,000,000 lbs.	4,800,000 lbs.
Production as % of Capacity	95%	95%	95%
Cost Reduction per unit of Product Produced	.0020	.0020	.0022
Depreciation Rates: New Equipment	6%	6%	6%
SAVINGS IN OPERATING COSTS			
Materials	$15,000.	$15,200.	$15,900.
Labor	(800.)	(900.)	(1,200.)
Steam	300.	300.	300.
Maintenance	(2,000.)	(2,050.)	(1,600.)
Depreciation	(2,400.)	(2,400.)	(2,580.)
Electricity	(300.)	(300.)	(300.)
TOTAL SAVINGS	$ 9,800.	$ 9,850.	$10,520.
Less: All Other Expenses Federal Income Tax 52% Other 5%	5,331.	5,358.	5,723.
NET SAVINGS	$ 4,469.	$ 4,492.	$ 4,797.
INVESTMENT			
Project Expenditures	$40,000.	$40,000.	$43,000.
Net Change in Working Capital	(1,920.)	(1,930.)	(2,080.)
Total Capital Required for This Project	$38,080.	$38,070.	$40,920.
RETURN ON INVESTMENT	11.7%	11.8%	11.7%

EXHIBIT 1

above statement discloses that, by the installation of the piece of equipment, the cost of finished product inventory and required essential material inventories have been reduced, as indicated by the net change in working capital. If the accomplishment report had shown a less return on investment after the first year's operation than predicted, a second such report would be prepared after the second full year of operation, to determine if any improvement had been made.

A statement concerning the following considerations should also accompany the accomplishment report by way of amplification:

1. *Review of objectives*—This should be a statement outlining the prior facilities (such as a coal or oil firing system) and comparing these facilities

in narrative form with the new facilities (such as a gas firing system), stating the objective which was expected to be accomplished and the prospective savings.

2. *General comments on conditions existing during the first year*—This may be sort of a historical sketch of the progress made in the first full year of operation, giving date the new facilities were put in use, the price fluctuations in materials used, production level as compared with estimate, and any other pertinent facts, especially costs incurred which may not have been anticipated in the forecast.

3. *Future Outlook*—Shown here may be a statement of what is expected from the project in the future, taking into account expected plant production level, price and wage rate changes anticipated, and any other factors which might influence the costs absorbed by the project. After giving full consideration to these factors, an estimated future yearly savings in operating costs should be shown along with a return on investment calculation. Any management is interested in knowing what is expected of its projects in future years, especially where these projects are planned on a return-on-investment basis.

Project Commitments and Expenditures — Their Effective Control

by G. E. OWEN

EXPENDITURES FOR FIXED ASSETS represent a relatively large portion of the total funds invested in a business. Because such expenditures are important to business operations, management develops long-term and short-term budgets based on the need for fixed assets and the availability of funds. In developing these budgets, management also considers future products, volumes, sources and sales markets. Approval of the budgets means that favorable consideration will be given by management to more detailed proposals, or projects, which involve the budget items and are submitted by operating or staff activities on a timely basis. After a project is approved, an appropriation is authorized. Upon notification of management approval, the activity which submitted the project is responsible for its execution of the project.

The successful execution of a project depends on the control of project commitments and expenditures. This ensures that (1) the purpose of the project is accomplished and (2) expenditures do not exceed the estimated cost of the project. The control of project commitments and expenditures is established by the following accounting instructions:

1. Project detail must allow control of applicable commitments and expenditures.
2. Commitment documents—for example, project purchase requisitions, work orders and other similar documents—must (a) refer to the project detail, (b) show the maximum dollar allowance for the project item or sub-item authorized to be committed by the purchasing agent, and (c) be approved by the controller before commitment of the available appropriations.
3. Available appropriations must cover the total indicated cost of the uncommitted work.
4. Expenditure documents—for example, vendors' invoices, work order charges and other similar documents—must refer to project detail and/or commitment documents.

G. E. OWEN, Detroit 1947, is Staff Analyst, Internal Management Consulting Services, Corporate Systems and Procedures Department, Chrysler Corporation, Detroit, Michigan. He was formerly a Supervisor, Corporate Auditing Department and later a member of the Comptroller's Staff.

Project Commitment and Expenditure Record — Form and Contents

The Project Commitment and Expenditure Record (Exhibit 1) is maintained by the accounting personnel to ensure compliance with the project accounting instructions and to record the project financial data in an orderly manner. This article explains its preparation and use. The record is prepared from project detail immediately after the project is approved.

PROJECT COMMITMENT AND EXPENDITURE RECORD

Item No.	Budget Ref. No.	Disposition Acct. No.	Mast. Tag No.	Date	Amount	Appropriation No.
Description						Supplement No.
						Division Number

	Sub Item No.	Description	Uncommitted Work: Authorized Amount Uncommitted	Uncommitted Work: Indicated Cost Inc. (Dec.)	D A T E	Commitments to Date: Commitment Reference	Commitments to Date: Amount	Purchase Order No.	D A T E	Actual Expenditures: Reference	Actual Expenditures: Amount	Transfer Reference
1												
2												

EXHIBIT 1

To make the project commitment and expenditure record an effective control document, the project detail must allow control of applicable commitments and expenditures. To do this, the project detail lists each equipment unit or individual job included in the project. Capital items are shown separately from expense items. Related costs of a project item—for example, installation of the equipment unit, freight and other similar costs—are shown on the project detail as sub-items. Project items and sub-items must be shown on the project detail in the order of their commitment.

A separate record form is prepared for each approved project item. Project information taken from the project detail is written in the top section of the record. The project item and/or sub-items are listed on the left side of the record and the appropriations for each are posted to the record. A separate record may also be prepared for each sub-item or groups of sub-items if it is desirable to spread the accounting work-load. The record is then filed in the active file by appropriation control number and by project item number.

The financial data on the completed project commitment and expenditure record is useful cost information. The project detail must allow the accumulation of such cost information. For example, a project detail is prepared for special tools to make an automotive part. Usually a "family" of special tools is needed. Possibly a blanking die, a draw die, a piercing die and other dies may be required by the production line-up. The project item is the estimated total cost of all special tools needed to make the part; the sub-items are the estimated costs of

each die in the production line-up. The cost information accumulated on the completed record saves time when preparing estimates of special tooling costs for similar automotive parts to be used on future models.

Posting Commitment Documents to the Record

When the controller receives committment documents for his approval signature, he must promptly:

1. Determine the project item or sub-item being committed and the appropriation available for the proposed commitment.
2. Compare the description and the amount of the proposed commitment with the description of the project item or sub-item and the appropriation available for the proposed commitment.
3. Endorse the commitment document if the description of the project item or sub-item is comparable with the approved project detail and if the appropriation available covers the project item or sub-item being committed.
4. Subtract the appropriation for the project item or sub-item being committed, and post the committed amount.
5. Notify the activity originating the commitment document of the delay in processing the commitment document if the proposed commitment does not agree with the description and/or the amount exceeds the appropriation available.
6. Prepare a supplemental request for appropriation if the total accumulated commitment amount plus the total indicated cost of the uncommitted work exceeds the appropriation by more than the allowed tolerance.
7. Prepare a request for deviation when changes of a physical nature —for example, added or deleted items, changes in quantities, substitution of materials and similar changes—are concerned.

Commitment amounts posted to the project commitment and expenditure record must be adjusted for differences between the commitment amount and the purchase order issued. Line reference numbers refer to posting previously made to the record, so that the current entries may be made in chronological order. Each month's entries are totaled and accumulated to date. This is done after the month's expenditures are posted to the record.

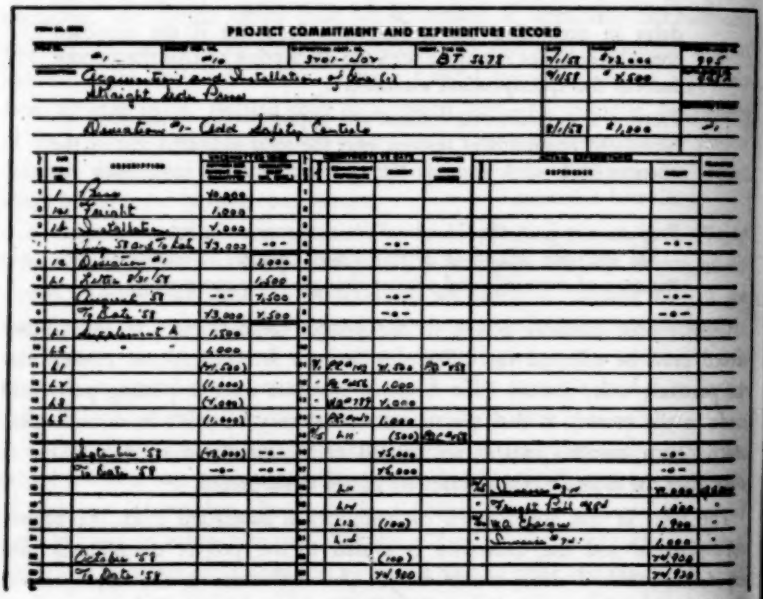
The total of the accumulated commitments is subtracted from the project appropriation and the difference is posted to the project commitment and expenditure record as a memo entry. This difference is the appropriation available for the uncompleted work. If the appropriation available is less

than the total indicated cost of the uncommitted work, the project is immediately subjected to a special review to determine the reason. The corporate activities directing the project must take any action necessary to prevent expenditures exceeding the project appropriation. If this cannot be done, the controller must obtain as already noted, a supplementary appropriation for the difference between the project appropriation and the latest estimated cost of the project.

If the activity preparing the project detail knows that the cost of any project item or sub-item will increase or decrease before the project item or sub-item is committed, a letter must be sent to the controller advising him of the latest revised estimate. The indicated increase or decrease in the cost is posted to the project commitment and expenditure record.

Posting Expenditure Documents to the Record

Accounting personnel perform their normal audit and payment functions when they receive expenditure documents. Approved expenditure documents are posted to the project commitment and expenditure record. Exhibit 2



PROJECT COMMITMENT AND EXPENDITURES RECORD

illustrates how the record is used. The expenditure may differ in price from the commitment amount. The commitment amount is adjusted to the expenditure. When all project items are completely committed and paid, the total commitments and the total expenditures shown on the record are equal.

The difference between the purchase order amounts and the total amounts of partial or incomplete billings is posted as a memo entry. This helps accounting personnel to quickly reconcile the difference between the total commitments and the total expenditures of incompleted project items.

If a project item is classified as an asset, the journal voucher reference is posted to the project commitment and expenditure record when the asset cost is capitalized. The equipment tag number is also posted to the record. The record is then removed from the active file and is filed with the project documents.

Accounting Education and E. D. P.

by FRANK V. McKEE*

EACH CONVERSION to automatic equipment is accompanied by new possibilities of error which must be disclosed by new methods. Errors may occur in converting data to punched cards or magnetic tape, in the preparation of control boards or through incorrect usage of data in tabulated form. Since machines cannot reason (only evaluate, tabulate, summarize, etc.), the accountant must understand machine methods of developing data and be capable of establishing and policing controls points.

In view of this, what changes in course content can be made by educational institution which would enhance their value to accounting students? One possibility would be a laboratory type course in which equipment would be made available to students. They would learn basic principles concerning the use of this equipment and become aware of "danger areas" and control points. The use of slide projection equipment and motion pictures for lectures would also be a start in the right direction. Field trips to demonstrations conducted by data processing equipment manufacturers and to accounting organizations of large business concerns which use such equipment, could also be helpful.

In many business concerns, today there are more job openings for accountants with a working knowledge of the uses of data processing equipment than for those with no knowledge of the subject. The need for formal training in this field is increasing rapidly and educational institutions must revise and expand their curricula to meet the demand.

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Beyond These Covers

Books

Opportunities in Accounting

Raymond G. Ankers, Vocational Guidance Manuals, Inc., 1011 E. Tremont Avenue, New York 60, N. Y. Paper Bound, 1958, 118 pp.

Covering not only public but private accounting and the teaching of accounting, this is a clearly written factual volume portraying the nature of and educational requirements for the accountant and the conditions under which he finds himself doing this work, together with discussion of advancement prospects. In connection with education, the problem of the high school student looking ahead for proper course content is dwelt on. The principal accounting associations are described. The book is furnished with a bibliography.

Cost Reduction at Work

American Management Association, 1515 Broadway, Times Square, New York 36, N. Y. Paper Bound, 1959, 84 pp., $2.25.

These reports of successful company practices (A.M.A. Report No. 28) reflect papers given at conferences in the fall and winter of 1958. Nine cases are included, among them procedures at duPont, Packard Bell Electronics and H. J. Heinz Co.

Bibliography on Profit Sharing

Bertram L. Metzger, Profit Sharing Research Foundation, 1718 Sherman Ave., Evanston, Illinois. Paper Bound, 1959, 40 pp., $1.

The full title of this pamphlet is "An Extensive, Indexed Bibliography of American Publications on Profit Sharing Between 1940-1958. The text also includes an article, "The Research Needs of Profit Sharing" by J. J. Jehring. Messrs. Jehring and Metzger are, respectively, Director and Assistant Director of the Profit Sharing Research Foundation.

Power Unlimited—The Corruption of Union Leadership

Sylvester Petro, Ronald Press, 15 East 26th St., New York 10, N. Y., 1959, 323 pp., $5.

A former union organizer, long a lawyer and editor, writes with conviction in this book on what is acknowledged to be a "hot" topic politically. Not a technical book, except possibly in labor relations, it includes some necessary references to union finances.

Articles

Exactly How Effective Is Your Advertising

Charles H. Pinkham, Business Budgeting, March 1959.

"Monthly sales and advertising figures for as many years as are available" form the raw material for a positive answer to the title question of this article. The paper is a reprint from *Printers Ink*, May 1957. One of the measurement features developed and illustrated in an, "index of advertising effectiveness."

Scientific Management of Marketing Operations

Al. M. Soares, Society for Advancement of Management, 1959, Pamphlet, 35 pp., $1.50.

A monograph by a former vice-president of Remington Rand and present president of the National Sales Executive-International, this "modern management treatise" considers the organization, planning and "strategy" of marketing, with attention to such topics as the place of "new product" decisions, intelligence activities in marketing, techniques of market analysis, and developing the field sales organization.

Systems Design and Internal Control Related to Automated Data Processing
Paul E. Hamman

The Development of Systems and the Application of Electronic Data Processing
David V. Savidge

The Economic Impact of Electronic Data Processing
Kenneth C. Tiffany

Appearing in the March 1959 issue of *The Federal Accountant*, this group of articles is reported from a symposium held last November on "Management and Electronic Data Processing." The articles are generally informative in character and do not primarily relate to government work.

IDP Applied to Monthly Closing
Robert F. Van Loon, Cost and Management, February 1959.

With the experience of a plant of an agricultural equipment manufacturing company as background, this article describes the progressive steps from journal entry cards to trial balance using tabulating equipment. A small additional expense is acknowledged, counter-balanced by earlier closings and a better work schedule within the month.

The Auditor Encounters Computers
Charles E. Grady, The Internal Auditor, March 1959.

The "audit trail" (whether lost or whether only obscured is the question raised) and what is required of the auditor as to knowledge of the place of a computer in internal control and as to acquaintance with the "hardware" and with programming techniques, are principal topics given attention here. The author outlines a 7-day course utilized for his staff in cooperation with an equipment manufacturer.

Distribution Costs
Howard B. Burdeau, The Cost Accountant, February 1959.

This is a comprehensive general article on utilization of distribution costs and covers a number of types of analyses which may prove practicable, including "nature or object of expense," "functional analysis," "manner of application," "channels of distribution and methods of sale," "commodities" and "customers." The use of standards and budgets in distribution costing is also treated.

Base-Point Labor Distribution
C. W. Bastable, The Controller, March 1959.

An hourly distribution rate for each employee, embracing vacation pay and other benefit costs, is central to the labor costing technique explained in this article. Provision is also made in the use of this procedure for facilitating charging of proper departments when an employee works in more than one.

ADDRESSES OF PERIODICALS

Business Budgeting
528 W. 12th Street
Covington, Kentucky

The Federal Accountant
1523 L St., N. W.
Washington 5, D. C.
Single copy: $1.25

Cost and Management
31 Walnut St. South
Hamilton, Ont., Canada
Single copy: 50¢

The Internal Auditor
120 Wall Street
New York 5, N. Y.
Single copy: $1.00

The Cost Accountant
63 Portland Place
London W. 1

The Controller
2 Park Avenue
New York 16, N. Y.
Single copy: 65¢